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BOARD OF TRANSPORT COMMISSIONERS FOR CANADA

REPORT

ON THE

RAILWAY-HIGHWAY CROSSING PROBLEM IN CANADA

Made pursuant to Order-in-Council
P.C. 1953-52 of January 14th, 1953

OTTAWA, CANADA—MAY 10, 1954

EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1954.

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Canadian Transport Commissioners
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(BOARD OF TRANSPORT COMMISSIONERS FOR CANADA)

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IN CANADA



BOARD OF TRANSPORT COMMISSIONERS FOR CANADA

OTTAWA, May 10, 1954.

To His Excellency the Governor General in Council.

MAY IT PLEASE YOUR EXCELLENCY:

I have the honour to hand you herewith the report of the Board of Transport Commissioners, pursuant to the Order in Council of January 14, 1953, P.C. 1953-52, a copy of which is hereto attached.

Your obedient servant,
JOHN D. KEARNEY.

Hon. Mr. Justice JOHN D. KEARNEY,
Chief Commissioner.

P.C. 1953-52

PRIVY COUNCIL

CANADA

AT THE GOVERNMENT HOUSE AT OTTAWA

WEDNESDAY, the 14th day of January, 1953.

PRESENT:

His EXCELLENCY THE GOVERNOR GENERAL IN COUNCIL:

WHEREAS the railway-highway crossing problem in Canada as a result of expanding motor vehicle traffic and improved highways has become one of national concern in respect of the present need for protection, safety and convenience of the public;

AND WHEREAS it is deemed to be in the public interest that an inquiry be made into all matters involved in the problem of railway-highway crossings which come under the jurisdiction of the Parliament of Canada;

AND WHEREAS section 38 of the Railway Act provides that the Governor in Council may at any time refer to the Board of Transport Commissioners for a report, or other action, any question, matter or thing arising or required to be done under the Railway Act or any other Act of the Parliament of Canada.

THEREFORE, His Excellency the Governor General in Council, on the recommendation of the Minister of Transport and under and by virtue of section 38 of the Railway Act, is pleased to direct and doth hereby direct that the Board of Transport Commissioners for Canada make an investigation and report on all phases of the problem of railway-highway crossings which are under the jurisdiction of the Parliament of Canada in respect of the present and prospective need for the protection, safety and convenience of the public, and without limiting the generality of the foregoing the Board shall

- (a) conduct a survey and report on the methods considered by the Board to be practicable under all pertinent circumstances of eliminating the hazards and improving the public convenience and the protection and safety of the public at such crossings;
- (b) review and report on the adequacy of The Railway Grade Crossing Fund to provide for the construction of works for the protection, safety and convenience of the public in respect of railway-highway crossings; and
- (c) make such recommendations as the Board may deem advisable in the premises.

J. W. PICKERSGILL,
Clerk of the Privy Council.

The Minister of Transport.

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FOREWORD

The ensuing report has been made following Canada-wide hearings extending over a period of nearly eleven months. It is the first of its kind which has been undertaken since the creation of The Railway Grade Crossing Fund in 1909, hereinafter sometimes referred to as the Fund.

Apart from the factual and legal matter gathered by way of evidence and briefs, through its long association with the Fund, the Board has acquired a record of notes and observations based on experience and accumulated much statistical data over the years.

How to make fitting use, in the presentation of this report, of the abundant material at the disposal of the Board has not been the least of its difficulties.

To begin with, an endeavour has been made to make certain to include sufficiently detailed facts and figures to enable readers to form an opinion as to the propriety or otherwise of the recommendations contained herein. In addition, while realizing the undesirability of including too much data, the Board has sought to make its report sufficiently replete for use as a source of necessary information should the need for any further investigation arise and obviate the later necessity of having to go over the same ground as is being presently traversed.

It is of necessity a lengthy document, including as it does *inter alia* a description of the historical and legal background of the railway grade crossing problem as well as essential statistical data.

In order that those who may be called upon to deal with the report may obtain a condensed outline of its essence, the Board, beginning at page 110, has set out "Considerations Leading up to Recommendations" and "Recommendations With Regard to The Railway Grade Crossing Fund Entailing Changes in The Railway Act."

APPEARANCES OF COUNSEL

R. KERR, Q.C.	} Board of Transport Commissioners	
P. F. BAILLARGEON		
K. D. M. SPENCE		
G. P. MILLER		Canadian Pacific Railway Company
F. H. BRITTON		
J. W. G. MACDOUGAL		
A. H. HART		
E. B. McDONALD		Canadian National Railways
W. H. HEWSON		
GUSTAVE GARNEAU, Q.C.		
L. COTE, Q.C.		
HAL SOULE		Toronto, Hamilton & Buffalo Railway Co.
F. A. BURGESS		The Bell Telephone Company of Canada
J. J. FRAWLEY, Q.C.		Province of Alberta
DEAN F. C. CRONKITE, Q.C.		Province of Saskatchewan
C. D. SHEPARD, Q.C.		Province of Manitoba
E. B. MACLATCHY		Deputy Attorney General, Province of New Brunswick
Hon. P. J. LEWIS, Q.C.		Province of Newfoundland
LEON METHOT, Q.C.		Department of Roads, Province of Quebec
J. G. KIDD		City of Medicine Hat
E. M. BREDDIN		City of Calgary
THOMAS E. GARSIDE, Q.C.		City of Edmonton

R. D. PHILLIPS.....	City of Saskatoon
G. F. STEWART, Q.C.....	City of Regina
DUNCAN LENNOX.....	City of Winnipeg
A. J. POLSON, Q.C.....	City of Hamilton
F. A. A. CAMPBELL, Q.C.....	City of Toronto
A. P. G. JOY.....	City of Toronto
F. G. GARDINER, Q.C.....	Municipality of Metropolitan Toronto
HOLLIS BECKETT, Q.C.....	Township of Scarborough
DAWSON A. McDONALD, Q.C.....	City of Montreal
ERNEST GODBOURG, Q.C.....	City of Quebec
A. POUPART, Q.C.....	City of Lachine
C. J. A. HUGHES, Q.C.....	City of Fredericton
HENRY D. HOPKINS.....	City of Saint John
RICHARD A. DONAHUE, Q.C.....	City of Halifax

BRIEFS AND EVIDENCE PRESENTED AT PUBLIC HEARINGS

At Vancouver

Province of British Columbia.....	H. A. MacLean, Dept. of Public Works Neil McCallum, Chief Engineer, Dept. of Public Works
City of Vancouver.....	J. C. Oliver, City Engineer

At Calgary

City of Calgary.....	E. C. Thomas, City Engineer
----------------------	-----------------------------

At Edmonton

Province of Alberta.....	Hon. Gordon Taylor, Minister of Highways
City of Edmonton.....	William Hawrelak, Mayor
City of Wetaskiwin.....	Gordon Brownlee
Alberta Safety Council.....	A. R. Lawrence, Director and Safety Engineer
Farmers' Union of Alberta.....	Henry Young

At Saskatoon

City of Saskatoon.....	R. D. Phillips
City of Prince Albert.....	H. McL. Weir, Consultant Engineer
Town of Lloydminster.....	Joseph W. Oliver, City Commissioner
Town of Watrous.....	(1)
Town of Melfort.....	(1)
Saskatchewan Farmers' Union.....	President, Melfort Board of Trade Secretary, Melfort Board of Trade Town Councillor, Melfort, Sask. Wm. Burianyk

At Regina

Province of Saskatchewan.....	W. M. Stewart, Deputy Minister, Dept. of Highways and Transportation
City of Regina and Province of Saskatchewan.....	G. F. Stewart, Q.C.
City of Moose Jaw.....	(1)
Town of Humboldt, Sask.....	(1)
Town of Watson, Sask.....	(1)
Town of Foam Lake, Sask.....	(1)
Sask. Assoc. of Rural Municipalities.....	Stanley Ferguson, Secretary-Treasurer
Rural Municipality of Buckland 491, Prince Albert.....	(1)
Rural Municipality of Hart Butte, No. 11. Wm. Wagner, Councillor	
Rural Municipality of Kinley, No. 36,	
Village of Midale.....	Peter Hultgren, Councillor
Village of Coronach, Sask.....	Mr. Brandiez, Councillor
Village of Quill Lake, Sask.....	(1)
Saskatchewan Urban Municipalities Association	(1)
All Canada Insurance Federation.....	L. R. Hurd, Businessman, City of Regina W. J. McIntyre, Businessman, City of Swift Current

(1) Brief filed, no witness called.

At Winnipeg

Province of Manitoba.....	George Collins, Deputy Minister of Public Works
City of Winnipeg.....	Duncan C. Lennox, Assistant City Solicitor
Winnipeg Chamber of Commerce.....	A. J. Taunton, Engineering Department Evan McCormick

At Port Arthur

City of Port Arthur.....	F. O. Robinson, Mayor
Joint Transportation Comm. Fort William- Port Arthur Chambers of Commerce.....	E. G. Charnock, Chairman
Wood Preservers.....	Robert Prettie

At Windsor

City of Windsor.....	J. E. Watson, Solicitor
Essex Terminal Railway.....	H. J. Desmarais, City Engineer S. E. McGorman, Chief Engineer

At London

City of London.....	R. H. Cooper, City Clerk
---------------------	--------------------------

At Hamilton

City of Hamilton.....	A. J. Polson, Q.C. Les. Parker, Acting Mayor
	Mr. Lanza, Alderman Wm. Walsh, Alderman

At Toronto

Province of Ontario.....	V. H. Longstaffe, Assistant Engineer, Dept. of Highways
City of Toronto.....	L. H. Saunders, Acting Mayor L. B. Allan, Chief Engineer and Commissioner of Works
Township of East York.....	D. A. Balfour, Controller
Scarboro Township.....	J. D. Corcoran, Engineer
Town of Weston.....	H. F. Burt, Planning Board
Robertson Steel Products.....	G. H. Clarkson, Town Clerk R. F. Fender

At Montreal

City of Hull.....	(1)
The Bell Telephone Co. of Canada.....	F. A. Burgess

At Quebec

Province of Quebec.....	Léon Méthot, Q.C., Dept. of Roads
City of Quebec.....	Ludger Gagnon, Asst. City Engineer Edouard Fiset, Town Planning Advisor
	Roland Bédard, Town Planning Advisor
	C.-J. Bédard, Alderman
City of Lévis.....	Adrien Begin, Secretary, Chamber of Commerce
City of Three Rivers.....	(1)
Quebec Chamber of Commerce.....	R. Vézina, Secretary L.-A. Desrosiers J.-E. LeBoeuf

At Fredericton

Province of New Brunswick.....	A. S. Donald, Deputy Minister, Provincial Public Works Dept.
	E. B. MacLatchy, Deputy Attorney General
	W. J. Lawson, Assistant Chief Highway Engineer
	R. A. Malloy, Chief Bridge Engineer
County of Saint John and City of Saint John.....	Walter J. Campbell, Warden
City of Moncton.....	(1)
City of Fredericton.....	Mr. Hughes
Saint John Town Planning Commission.....	P. R. Fowler
N.B. Safety League.....	D. Laidlaw, Secretary

(1) Brief filed, no witness called.

At Halifax

Province of Nova Scotia..... R. W. McColough, Ex. Asst. to Minister, Dept. of Highways and Public Works
 City of Halifax..... Richard A. Donahue, Q.C., Mayor

At Charlottetown

Province of Prince Edward Island..... Hon. Walter E. Darby, Attorney, Advocate-General and Provincial Treasurer

At St. John's

Province of Newfoundland..... Hon. E. S. Spencer, Minister of Public Works

At Ottawa

Canadian National Railways..... J. W. G. Macdougall
 Canadian Pacific Railway Co..... G. P. Miller
 Province of Saskatchewan..... W. M. Stewart, Deputy Minister, Dept. of Highways
 Province of Newfoundland..... (1)
 Province of Quebec..... J.-O. Martineau, Assistant Chief Engineer, Department of Highways
 City of Montreal..... C.-A. Auclair, City Engineer
 City of Moncton..... (1)
 City of Lachine..... A. Poupart, Q.C.
 Township of Scarborough, Ont..... (1)
 Canadian Good Roads Assoc. R. A. Draper, Assistant Managing Director
 Canadian Federation of Agriculture..... Dr. E. C. Hope
 Railway Transportation Brotherhoods.... J. L. D. Ives, Chairman, Dominion Joint Legislative Committee
 Brotherhood of Locomotive Engineers.... J. B. Ward, Dominion Legislative Representative

OTHER SUBMISSIONS AND CORRESPONDENCE FILED WITH BOARD

A. S. Donald, Deputy Minister, Department of Public Works, New Brunswick	City of Sarnia, Ontario.
Joint Memorandum of the City of Quebec and of the Quebec Board of Trade.	City of Guelph, Ontario.
Saskatchewan Motor Transport Assoc.	City of Oshawa, Ontario.
Saskatchewan Motor Club.	City of Peterborough, Ontario.
Rural Municipality of Estevan No. 5, Saskatchewan.	City of Hull, Quebec.
Rural Municipality of Bjorkdale No. 426 Crooked River, Saskatchewan.	City of Lachine, Quebec.
Town of Kerrobert, Saskatchewan.	City of Verdun, Quebec.
City of London.	City of Moncton, New Brunswick.
City of Calgary, Alberta.	City of Kitchener, Ontario.
City of Saskatoon, Saskatchewan.	City of Toronto, Ontario.
City of Fort William, Ontario.	Township of Crowland.
City of Port Arthur, Ontario.	Township of York.
City of Timmins, Ontario.	Administrative Committee, City of Quebec.
City of Sudbury, Ontario.	County of Bonaventure, New Carlisle, Quebec.
City of Windsor, Ontario.	Peave River Districts Women's Institute.

LIST OF PUBLIC HEARINGS

Vancouver, B.C.....	March 16, 1953.
Calgary, Alta.....	March 26.
Edmonton, Alta.....	March 30.
Saskatoon, Sask.	April 7.
Regina, Sask.	April 13 & 14.
Winnipeg, Man.	April 17.
Port Arthur, Ont.	April 20.
Windsor, Ont.	June 8 & 9.
London, Ont.	June 10.
Hamilton, Ont.	June 11.
Toronto, Ont.	June 16.

(1) Brief filed, no witness called.

Fredericton, N.B.	June 29 & 30
Halifax, N.S.	July 3.
St. John's, Nfld.	July 9.
Charlottetown, P.E.I.	July 14.
Montreal, Quebec....	Sept. 16.
Quebec, Quebec.....	Sept. 17.

FINAL GENERAL HEARING

Ottawa, Ontario.....Feb. 3 & 4, 1954.

I. Grade Crossing Accidents

This report is the result of an investigation made pursuant to Order-in-Council P.C. 1953-52, January 14, 1953, which, inter alia, directed the Board of Transport Commissioners for Canada to:

- "(a) conduct a survey and report on the methods considered by the Board to be practicable under all pertinent circumstances of eliminating the hazards and improving the public convenience and the protection and safety of the public at such crossings;
- (b) review and report on the adequacy of the Railway Grade Crossing Fund to provide for the construction of works for the protection, safety and convenience of the public in respect of railway-highway crossings; and
- (c) make such recommendations as the Board may deem advisable in the premises."

The Board, through its administration of the Fund has been directly concerned with the grade crossing problem for many years. In undertaking our investigation we were, therefore, able to draw upon our extensive experience over this long period during which the problem of protection of grade crossings has been continually before us. In this report we shall endeavour to consider the subject of grade crossing accidents and protection in appropriate perspective: their intrinsic importance, their importance relative to other matters of national concern, and the most practical and efficient means of meeting the problem as evaluated. This is perhaps of more than usual importance in an investigation of this type which, insofar as the seriousness of the problem and the widespread desire for some remedial action are concerned, was almost entirely non-controversial. However, as to the methods of assistance and the amount of the assistance that should be provided by the Federal Government, we have found considerable diversity of views and it is to this part of our inquiry that our major attention and consideration must be directed.

The Highway-Railway Crossing Accident Record

Statistics of accidents at grade crossings have been compiled for many years and are sufficient to reveal the general trends. A highway crossing accident is defined in these statistics as one which has resulted in death or injury. Accidents in which property damage has been incurred, no matter how great, are not included in the figures if there were no deaths or injuries to persons in connection with them, nor are there any estimates made of property damage in accidents involving death or injury.

At first thought this might seem to limit the value of the statistics, for, as is well known, property damage may be extremely heavy in crossing accidents. We have, however, taken the view that the basic reason for regarding the

grade crossing situation as one of national concern is the increasing toll of deaths and injuries resulting from such accidents; secondarily it is relief from traffic congestion. A property loss alone, whether through inherent danger or carelessness, is a matter of an entirely different order than loss of life or injury however it may have been caused. We have therefore refrained from any attempt to fill out the available statistics with estimates of property damage, and above all from any attempt to express in the common denominator of dollars and cents the total losses from deaths, injuries and damage to property. Any such attempts are bound to give inadequate results, and would be unnecessary since risk of death or injury must ordinarily mean risk of property damage and protection against death or injury will likewise mean protection against property damage.

In Table 1 the data on accidents are paralleled by the data on train miles and number of motor vehicle registrations from 1908 to 1952. The number of casualties shows a considerable fluctuation from year to year but an upward trend since 1938 is clearly evident. No simple correlation exists between the number of killed and injured and the traffic factors that are also shown, but the latter reveal sufficiently well the growth of the problem. As might be expected, train miles show relatively small variation, since heavier traffic may be offset by the use of heavier locomotives and longer trains. The steady increase in motor vehicle registrations, broken only by the depression and wartime restrictions, indicates why the problem has now assumed serious proportions. Motor vehicle registrations have more than doubled since 1945 and since 1947 the number of crossing accidents in each year has exceeded 400. Unless offset by other factors, including greater protection, the increase in highway traffic may very shortly raise the number of accidents to over 600 a year.

A comparison of the casualties at urban and rural crossings reveals some secondary trends. Until 1920 the number killed and injured at urban crossings tended to be equal to or greater than that at rural crossings, reflecting the greater accident potential at urban crossings in the period before the building of trunk highways. Since 1920 the number of casualties at rural crossings has tended to be greater. Increased traffic at higher speeds on rural roads and highways, together with concentration of protective devices or separation projects at urban crossings, would account for this trend. During the depression years the toll of accidents fell off, particularly during the years 1931 to 1934. In fact, for some time it might have appeared that the improvement was to be more than a temporary one for urban crossings, as the minimum of only 14 deaths was reported in 1938 and the accidents did not touch the pre-1929 levels until 1947. However, the upward trend at rural crossings was resumed in 1935 and the number killed has fluctuated between 82 and 124 in the following years. Since 1947 there has also been a sharp increase in the number killed or injured at urban crossings.

Before proceeding further in analyzing grade crossing accidents, it would be well to see the grade crossing problem in its proper setting in relation to all highway accidents. The spectacular and particularly disastrous nature of many grade crossing accidents is perhaps responsible for a tendency on the part of the general public to overestimate their frequency. Actually they comprise only between 1 per cent and 2 per cent of all highway accidents.

ACCIDENTS ACCCOMPANIED BY DEATH OR INJURY

Year	All Highway	Grade Crossing	Percent Grade Crossing of all Highway Accidents
1948.....	29,508	414	1.4
1949.....	33,435	441	1.3
1950.....	27,869*	457	*
1951.....	41,691	490	1.2
1952.....	44,156	463	1.0

*Province of Quebec figures not included in 1950.

A provincial distribution of the highway traffic and accident factors is given in Table 2. There are wide differences between the provinces by way of size, population density, the use made of motor vehicles and other details not shown, which account for some of the variations in the table. There is one motor vehicle for every four persons in Ontario and the western provinces, about half this density in the eastern part of Canada. Ontario has the greatest density of motor vehicles per mile of road, followed by British Columbia, and Quebec. Grade crossing accidents per motor vehicle appear to be in a high ratio in both Prince Edward Island and New Brunswick and at a lower comparative level in the two largest provinces, Ontario and Quebec.

A comparison of the grade crossing situation as between Canada and the United States is provided below:

	United States	Canada	Percent Canada of U.S.
<i>Number of Grade Crossing Accidents—</i>			
1950.....	3,662	457	12.5
1951.....	3,653	490	13.4
1952.....	3,294	463	14.1
<i>Number of Grade Crossing Accidents per Million Train Miles—</i>			
1950.....	4.19	3.58	.....
1951.....	4.13	3.58	.....
1952.....	3.88	3.31	.....
<i>Millions of Motor Vehicles (1952).....</i>			
Miles of Railway (1951).....	52.6	3.2	6.1
Crossings, protected.....	224,431	42,978	19.1
Crossings, unprotected.....	35,968	3,230	9.0
Total (U.S.—1950).....	191,396	29,323	15.3
Percent protected crossings.....	227,364	32,553	14.3
	15.8	9.9	

While the number of grade crossing accidents in Canada was 14.1 per cent of the United States total in 1952, the number of accidents per million train-miles was appreciably less. Difficulties in comparison may be noted in that there were 52.6 million motor vehicles in the United States compared with Canada's 3.2 million. Progress in the protection of crossings has advanced considerably further in the United States with 15.8 per cent of crossings protected as against 9.9 per cent in Canada. There is a greater railway mileage per capital in Canada and also a greater number of grade crossings per capita. With Canada's population approximately 9 per cent of that of the United States, Canadian railway mileage is 19.1 per cent of the United States mileage and Canadian grade crossings 14.3 per cent of those in the United States. On the other hand, Canadian motor vehicles are only 6.1 per cent of the number in the United States.

Location of Grade Crossing Accidents

In conjunction with its present investigation, the Board undertook a survey of highway crossings on railways under its jurisdiction, classifying them by types of protection, class of highway and railway and type of highway surface. Accidents during the years 1946 to 1952 inclusive were related to the particular crossing at which they occurred.

From this data it was possible to derive an index of accident frequency at the various types of crossings, which in Table 3 is stated as the number of accidents per year per hundred crossings of each type. Table 4 shows the breakdown by provinces for the categories listed in Table 3. Applied to the total number of crossings in the survey this admittedly crude measure of accident frequency does serve to point out those types of crossings where the danger is greatest. To this extent it is informative and useful but at the same time does not remove the need to assess each crossing individually in proceeding on any program of protection or crossing elimination.

Some explanation is necessary of the definitions used in the survey. Under "Class of Highway" three classes were distinguished: (1) "urban", referring to roads and streets in incorporated cities and towns, including those on provincial highway routes; (2) "provincial", referring to provincial trunk highways in rural areas only; (3) "rural", referring to all rural roads other than provincial trunk highways regardless of whether under provincial or municipal jurisdiction.

Railway lines were divided on a purely arbitrary basis between "main" and "other". The former were selected as comprising the main lines of the railways in question with the addition of such other lines where double track or fast or frequent train services occurred. The mileage classified as "main" amounted to 11,139 miles, or approximately one-quarter of Canadian railway mileage. The function of this distinction is merely to screen out the vast mileage of branch lines where average service is not at high speeds or of great frequency. That this purpose has been essentially accomplished is indicated by the predominance of "main" line crossings in the higher accident frequency groups as shown in the table.

Accidents reported are only those where fatalities or injuries have occurred. There is, in addition, a large number of crossing accidents every year in which no fatalities or injuries are incurred, but which involve varying amounts of property damage and temporary disruptions of rail schedules. The prevention of these accidents is, of course, as much a part of grade crossing protection as any other accidents, since the margin between escaping unharmed and incurring injury or death is often only a matter of seconds, combined with extreme good luck. The accident frequencies could therefore be raised to allow for the growing number of accidents involving property damage only.

In the seven years 1946-1952 there were 604 accidents at 1,771 protected level crossings, an accident frequency of 4.9 per year per 100 crossings. At 29,391 unprotected crossings there were 2,455 accidents, which amounts to a frequency of 1.2 accidents per year per 100 unprotected crossings.

The accident frequency at protected crossings from these data is thus approximately four times that at unprotected crossings which can only be due to the extremely high risk of accidents at crossings where traffic volume is heavy. The highest frequency recorded in the survey based on the above method of grouping was 13.0 at unprotected crossings of paved provincial trunk highways with main line railways. For the 88 crossings in this group,

80 accidents were reported in the period 1946-1952. At the other end of the scale, several small groups of crossings totalling 110 crossings in all had no accidents reported.

TABLE 1.—SIGNIFICANT STATISTICS ON GRADE CROSSING ACCIDENT PROBLEM IN CANADA

Year	Total Number of Accidents (¹)	Urban		Rural		Number of Train Miles (³)	Number of Automobile Registrations (²)
		Killed	Injured	Killed	Injured		
		(⁸)	(⁸)	(⁸)	(⁸)		
1908.....	N/A	30	35	21	33	83	3
1909.....	N/A	33	41	43	31	84	5
1910.....	N/A	28	45	35	16	90	9
1911.....	N/A	22	70	14	38	94	22
1912.....	N/A	33	43	42	41	105	36
1913.....	84	32	69	31	35	119	54
1914.....	131	49	72	32	50	113	74
1915.....	114	30	68	36	44	95	95
1916.....	101	26	68	41	30	114	128
1917.....	136	29	88	29	56	119	204
1918.....	139	40	76	33	56	114	277
1919.....	142	32	79	30	79	108	.....
1919.....	.....	39	95	30	98	112	342
1920.....	191	30	57	45	66	123	408
1921.....	189	35	60	49	100	108	465
1922.....	183	29	129	68	133	112	509
1923.....	241	24	124	50	144	120	576
1924.....	247	47	143	59	100	115	645
1925.....	257	35	154	46	197	114	724
1926.....	303	48	163	96	171	119	832
1927.....	314	36	147	60	200	123	940
1928.....	355	51	218	132	241	132	1,069
1929.....	390	35	190	93	266	124	1,187
1930.....	338	32	149	81	265	112	1,232
1931.....	320	33	166	51	55	97	1,201
1932.....	266	25	146	69	121	85	1,115
1933.....	218	26	109	52	138	78	1,083
1934.....	211	19	79	55	148	82	1,130
1935.....	242	28	88	93	140	84	1,176
1936.....	243	22	89	97	201	88	1,240
1937.....	286	23	86	94	252	91	1,320
1938.....	242	14	66	82	169	90	1,395
1939.....	243	17	79	83	203	96	1,439
1940.....	346	21	133	91	237	99	1,501
1941.....	380	27	107	109	323	115	1,573
1942.....	341	23	112	114	312	123	1,524
1943.....	301	22	127	82	271	130	1,512
1944.....	340	30	121	108	239	133	1,503
1945.....	382	31	196	90	274	131	1,497
1946.....	352	28	142	85	300	126	1,622
1947.....	442	41	195	110	306	131	1,836
1948.....	414	38	194	103	307	133	2,035
1949.....	441	50	223	90	267	130	2,291
1950.....	457	54	254	87	224	128	2,601
1951.....	490	67	213	124	309	137	2,868
1952.....	463	N/A	N/A	N/A	N/A	146	3,157

(¹) Accidents, Years 1908-1919 ending March 31. Years 1919-1952 ending Dec. 31st.

(²) Motor Registrations are by Calendar Years, source, Dominion Bureau of Statistics.

(³) Casualties and train miles for years 1908-1919 ending June 30th; years 1919-1951 ending Dec. 31st. From Statistics of Steam Railways, Dominion Bureau of Statistics.

TABLE 2.—COMPARISON OF POPULATION, MOTOR VEHICLES, ROADS AND ACCIDENTS 1952

Item	N'fld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
Population.....	374,000	103,000	653,000	526,000	4,174,000	4,766,000	798,000	843,000	970,000	1,198,000	14,430,000
Roads, Urban and Rural (1951).....	6,301	3,809	15,866	13,562	43,750	78,651	20,946	154,555	86,156	25,291	450,514
Motor Vehicles.....	23,630	18,717	114,982	89,839	574,974	1,291,753	187,881	237,014	291,469	321,482	3,155,824
Motor Vehicle Accidents with Death or Injury	198	159	1,726	968	11,393	17,193	2,128	2,463	2,825	5,041	44,156
Grade Crossing Accidents.....	3	2	15	17	89	192	30	37	49	29	463
Population Ratio Per Motor Vehicle.....	15.8	5.5	5.7	5.9	7.3	3.7	4.2	3.6	3.3	3.7	4.6
Motor Vehicles Per Mile of Road.....	3.8	4.9	7.2	6.6	13.1	16.4	9.0	1.5	3.4	12.7	7.0
Motor Vehicle Accidents Per 10,000 Motor Vehicles.....	83.8	84.9	150.1	107.7	198.1	133.1	113.3	103.9	96.9	156.8	139.9
Grade Crossing Accidents Per 10,000 Motor Vehicles.....	1.3	1.1	1.3	1.9	1.5	1.5	1.6	1.6	1.7	0.9	1.5

TABLE 3.—GRADE CROSSING SURVEY 1953—RAILROADS UNDER BOARD'S JURISDICTION

No.	Type of Protection	Type of Road Surface	Class of Highway	Main R.R. Line or Other Line	Number of Crossings	Number of Accidents 1946-1952	Rate of Accidents per 100 Crossings per year
1	Unprotected	Paved	Provincial	Main	88	80	13.0
2	Unprotected	Paved	Urban	Main	230	159	9.9
3	Gates	Paved	Rural	Main	6	4	9.5
4	Automatic Signals	Paved	Urban	Main	243	136	8.0
5	Gates	Paved	Urban	Main	87	49	8.0
6	Unprotected	Paved	Rural	Main	208	100	6.9
7	Automatic Signals	Paved	Rural	Main	182	81	6.4
8	Unprotected	Paved	Provincial	Other	582	255	6.3
9	Gates	Paved	Urban	Other	64	25	5.6
10	Unprotected	Gravel	Urban	Main	202	78	5.5
11	Automatic Signals	Paved	Provincial	Main	155	60	5.5
12	Automatic Signals	Paved	Urban	Other	318	119	5.3
13	Gates	Paved	Provincial	Main	7	2	4.1
14	Automatic Signals	Paved	Rural	Other	7	2	4.1
15	Automatic Signals	Paved	Provincial	Other	253	71	4.0
16	Unprotected	Gravel	Provincial	Main	114	32	4.0
17	Gates	Gravel	Urban	Main	4	1	3.6
18	Unprotected	Paved	Urban	Other	1,862	462	3.5
19	Automatic Signals	Paved	Rural	Other	117	27	3.3
20	Unprotected	Paved	Rural	Other	1,042	220	3.0
21	Unprotected	Unimproved	Urban	Main	67	10	2.1
22	Unprotected	Gravel	Urban	Other	1,111	140	1.8
23	Unprotected	Gravel	Rural	Main	2,254	249	1.6
24	Unprotected	Gravel	Provincial	Other	632	69	1.6
25	Automatic Signals	Gravel	Urban	Main	26	3	1.6
26	Automatic Signals	Gravel	Urban	Other	18	2	1.6
27	Automatic Signals	Gravel	Rural	Main	150	16	1.5
28	Automatic Signals	Gravel	Rural	Other	75	6	1.1
29	Unprotected	Unimproved	Urban	Other	460	32	1.0
30	Unprotected	Gravel	Rural	Other	7,127	330	.7
31	Unprotected	Unimproved	Rural	Main	1,759	89	.7
32	Unprotected	Unimproved	Rural	Other	11,602	160	.2

Other groups having no accidents include 59 protected crossings and 51 unprotected crossings.

TABLE 4.—GRADE CROSSING SURVEY 1953—CLASS OF CROSSING

No.	Type of Protection	Type of Road Surface	Class of Highway	Main R.R. Line or Other Line	Canada	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	Number of Crossings		B.C.			
															Prov. Hwy.	Prov. Hwy.				
1	Unprotected	Paved	Prov. Hwy.	Main	88	—	—	—	—	1	30	25	3	11	9	9	—	9		
2	Unprotected	Paved	Urban	Main	230	—	—	—	—	1	37	156	4	3	7	7	—	16		
3	Gates	Paved	Rural	Main	6	—	—	—	—	9	3	3	—	—	—	—	—	—		
4	Auto. Signals	Paved	Urban	Main	243	—	—	—	—	1	41	168	7	3	2	2	—	2		
5	Gates	Paved	Urban	Main	87	—	—	—	—	1	26	55	—	—	2	3	3	3		
6	Unprotected	Paved	Rural	Main	208	—	—	—	—	4	73	94	5	1	1	1	30	30		
7	Auto. Signals	Paved	Rural	Main	182	—	—	—	—	2	22	151	—	—	—	3	3	3		
8	Unprotected	Paved	Prov. Hwy.	Other	582	2	16	39	80	122	157	47	—	28	40	51	51	51		
9	Gates	Paved	Urban	Other	64	—	—	1	6	3	8	39	2	2	2	2	1	1		
10	Unprotected	Gravel	Urban	Main	202	—	—	1	1	2	13	113	19	16	36	36	2	2		
11	Auto. Signals	Paved	Prov. Hwy.	Main	155	—	—	—	—	5	13	42	85	3	—	3	9	9		
12	Auto. Signals	Paved	Urban	Other	318	1	5	—	28	18	71	145	12	8	13	13	17	17		
13	Gates	Paved	Prov. Hwy.	Main	7	—	—	—	—	3	—	2	—	—	—	—	—	—		
14	Auto. Signals	Paved	Rural	Other	253	1	5	—	45	40	46	91	4	1	1	1	1	1		
15	Unimproved	Paved	Prov. Hwy.	Main	114	—	—	—	—	2	25	14	4	42	4	4	8	8		
16	Unprotected	Gravel	Prov. Hwy.	Prov. Hwy.	—	—	—	—	—	—	—	—	—	—	—	—	23	23		
17	Gates	Gravel	Urban	Main	4	—	—	—	—	1	1	1	2	—	—	—	—	180		
18	Unprotected	Paved	Urban	Other	1,862	5	16	48	68	280	945	161	81	—	78	78	—	180		
19	Auto. Signals	Paved	Rural	Other	117	—	2	7	4	4	33	56	—	—	—	14	14	14		
20	Unprotected	Paved	Rural	Other	1,642	21	9	18	60	305	433	12	5	10	10	169	169	169		
21	Unprotected	Unimproved	Urban	Main	67	—	—	—	2	2	7	20	18	14	5	5	1	1		
22	Unprotected	Gravel	Urban	Other	1,111	13	2	103	59	86	364	124	122	150	150	88	88	88		
23	Unprotected	Gravel	Rural	Main	2,254	—	—	16	68	327	1,405	94	132	138	138	74	74	74		
24	Unprotected	Gravel	Prov. Hwy.	Other	632	6	6	2	6	22	23	85	336	90	56	56	56	56		
25	Auto. Signals	Gravel	Urban	Main	26	—	—	2	2	4	13	2	2	2	2	1	—	—		
26	Auto. Signals	Gravel	Urban	Other	18	—	—	5	2	6	12	112	1	—	1	3	3	3		
27	Auto. Signals	Gravel	Rural	Main	150	—	—	14	6	10	5	23	—	—	2	2	3	3		
28	Auto. Signals	Gravel	Rural	Other	75	—	2	14	11	6	18	69	116	91	70	70	51	51		
29	Unimproved	Gravel	Urban	Other	460	14	14	14	11	5	23	—	—	—	—	3	3	3		
30	Unprotected	Gravel	Rural	Other	7,127	75	50	482	382	889	2,349	585	898	1,056	361	361	361	361	361	
31	Unprotected	Unimproved	Rural	Main	1,759	—	13	5	13	5	235	448	611	898	1,056	48	48	48	48	
32	Unprotected	Unimproved	Rural	Other	11,602	117	127	78	130	235	379	2,586	5,512	5,512	2,586	2,586	91	91	91	91

Other groups having no accidents include 59 protected crossings and 51 unprotected crossings.

II. Historical Background of the Grade Crossing Problem

The grade crossing problem had its origin with the building of the first railroad in England, and the remedy there applied consisted largely of grade separations (i.e. overpass or underpass) designed when the railways were surveyed, or of gates in the few locations not so protected. In the new world the attendant circumstances of topography, population, traffic density, industrial development, and distance were sufficiently different that no justification existed for delaying or slowing progress in railway building so as to provide separations in step with construction.

Although the first railway in Canada was built in 1832 only 60 miles had been constructed by 1850. During the decade 1850 to 1860 some 2,000 miles of rail lines were built. Between 1860 and 1870 railway mileage increased to 2,617 miles, and by 1880 to 7,194 miles, and by 1890 totalled 13,151 miles.

The Railway Act of 1868 first authorized the establishment of the Railway Committee of the Privy Council, and the duties and powers of this body were greatly extended by a revision of the Act in 1888. In addition to certain regulatory powers the Committee was given the power to hear and determine any application respecting a number of specified subjects and "any matter, act or thing which by this or the Special Act is sanctioned, required to be done or prohibited." Grade crossing problems soon constituted an important part of the Committee's work: in 1889 the Committee approved applications for several level crossings, one road diversion and two overhead crossings. In the following year gates and watchmen were ordered at twelve grade crossings, while decision was reserved on applications for protection at twenty-one others. Relative to the times these would appear to have been substantial undertakings. However, they apparently fell short of meeting public demand, for the Committee's report for that year reveals that the public had become conscious of the grade crossing problem and was demanding more adequate and extensive protection.

During the next fifteen years the increase in railway mileage was paralleled by an increase in the number of crossings until by 1904 there were some 14,000 level crossings on the 20,000 miles of steam and electric railways in operation. In the same year 57 persons were killed and 232 persons injured.

This growing problem *inter alia* had led to a revision of the Railway Act in 1903 and in addition to the duties of the Railway Committee which were transferred to it the newly authorized Board of Railway Commissioners was given powers respecting: (a) highway crossings over railways, (b) railways crossing and running along streets and highways.

Even with its extended powers, the newly established Board soon found that the grade crossing problem was not amenable to any simple treatment. The number of crossings in the dangerous category was increasing faster than special protection could be installed, and the resources of the railways and municipalities were plainly insufficient to keep up with the situation.

The difficulty of the Board's position lay in the fact that it was made responsible for insuring an adequate standard of protection but it was manifestly impracticable to set an ideal standard of adequacy when the scale of protective work was strictly dependent upon the financial position of the railways and municipalities. It was in recognition of this difficulty that Parliament amended the Railway Act in 1909 to set up The Railway Grade Crossing Fund.

The original Railway Grade Crossing Fund legislation was contained in Section 239A which was added to the Act in 1909 (8-9 Edward VII Chapter 32, s. 7). The main provisions to be noted are:

SUBSECTION (1): Parliament was to vote the sum of \$200,000 annually for five years beginning April 1, 1909, "for the purpose of aiding in the providing by actual construction work of protection, safety and convenience for the public in respect of highway crossings of the railway at rail level." The crossings referred to were those in existence on April 1, 1909.

SUBSECTION (2): The Fund was to receive the money voted under Sub-section 1 to use solely toward the cost of actual construction work. It was explicitly stated that this did not include cost of maintenance or operation.

SUBSECTION (3): No contribution from the Fund could exceed 20 per cent of the cost up to a maximum of \$5,000. No grants could be made to more than 3 crossings in any one municipality in any one year or more than once to any one crossing.

SUBSECTION (4): Opened the way for the Provinces to contribute to the Fund, and the Board was authorized to use this money subject to any conditions or restrictions made by the Province. (No contributions by provinces have ever been made to the Fund).

After the first full year of administering the Fund, the Board reported on the matter in the following words:

While some progress had been made during the year the least consideration of the question shows how difficult the matter is to deal with. The expense of a separation of grade is always a costly work, the local municipality almost always objects to contributing, and of course should not contribute as much as the railway company; in some instances it should not contribute at all; the statute limits the contributions from the Grade Crossing Fund to \$5,000 for any one work, so the principal portions of the cost must always fall upon the railway company, probably it is upon the company that the burden should mostly fall, but it will be at once seen that any undue haste would impose enormous capital expenditure upon the companies, which would probably be found to not have much earning power; of course there are many cases where grade separation works economy in operation, but this is confined mostly to the cities. Protection at level crossings by means of electric bells, flagmen, and gates has been required in many places where grade elimination was impracticable either from physical or financial reasons; these modes of protection greatly increase the expense of operation while in the majority of cases there is no apparent source from which any increased earning is to come, so while the members of the Board, both personally as well as administrative body, are keenly alive to the necessity of protecting the public from the ever-increasing dangers at level crossings, they are confronted with many difficulties. A careful analysis of the accidents that happen at level crossings will show that at least eighty per cent arise from the carelessness of the individual using the highway and not from the carelessness of the trainman.

If undue burdens are imposed upon the railways in the way of increased expenditure of operation, or increased capital that is unremunerative the end is plainly seen. Some of the companies may face these expenditures with equanimity, but as to others it would probably mean unreasonably impoverished dividends or increased rates. Again, many municipalities enter into agreements with the railway companies proposing to construct new lines and, to some extent in some cases, tie the hands of the Board before it has a chance to intervene.*

With few exceptions, these words would be equally applicable today.

Since the establishment of the Fund there have been amendments from time to time. In general, these changes have been towards increasing Federal participation in grade crossing projects. Each enactment has been for a limited period, necessitating a further amendment at expiry of the term in order to maintain the annual appropriations to the Fund. The principal amendments to The Railway Grade Crossing Fund section of the Railway Act have been the following:

June 12, 1914: The time within which the Fund was made available was extended for ten consecutive years from April 1, 1909, at \$200,000 per annum.

June 6, 1919: The time was extended for ten consecutive years from April 1, 1919, at \$200,000 per annum.

July 7, 1919: The percentage contribution to the cost of construction work was increased to 25 per cent, and the maximum to \$15,000 for any one crossing. The contribution limit of three crossings in any one year in any one municipality was increased to not more than six crossings in any one year on any one railway in any one municipality. The proviso that no crossing should receive benefit more than once was changed to not more than once in any one year.

June 15, 1926: The percentage was increased to 40 per cent of the cost and the maximum to \$25,000.

June 11, 1928: Unexpended grants under the amendments of 1909, 1914, and 1919 were credited to the Fund. The percentage contribution limit of 40 per cent was unchanged but the maximum was increased to \$100,000. It was further provided that the Fund could be made available for grade crossings at rail level constructed after April 1, 1909, where an agreement between the municipality and the railway as to the division of cost had been concluded and approved by the Board.

June 14, 1929: The time within which the Fund was to be available was extended for ten consecutive years from April 1, 1929, at \$200,000 per annum.

Expenditures from the Fund were low during war years due to labour and material being directed to war purposes, and recommendations were made for protection at highway crossings only when absolutely necessary. No additions were voted to the Fund between 1940 and 1947.

July 17, 1947: The sum of \$200,000 a year was granted to the Fund from April 1, 1947, for ten years.

May 14, 1948: The grant was increased to \$500,000 a year from April 1, 1948, for a period of nine consecutive years.

June 1, 1950: The maximum contribution for any project was raised to \$150,000 but the percentage limit remained unchanged at 40 per cent. The sum of \$500,000 was granted each year for two consecutive years from April 1, 1949, and one million each year for six consecutive years from April 1, 1951. These are the conditions in effect at the present time.

Special Appropriations for Grade Crossings

Apart from the statutory appropriations to the Fund, there have been two other types of financial assistance made by the Federal Government for this work. The first has been the special appropriation of additional grants to the Fund. Such grants were incorporated into the Fund and the same rules and procedures were applied as to the statutory grants. In 1930 \$500,000 was transferred from the Unemployment Relief Fund to the Fund, and in 1932 \$500,000 was similarly transferred from the Unemployment and Farm

(*) Annual Report of the Board of Railway Commissioners for Canada, 1909-1910, p. 39.

Relief Fund. Parliament approved a special vote of \$500,000 to the Fund in 1934, and special votes to the Fund of \$300,000 in 1938 and \$500,000 in 1939 were made.

The second type of special assistance consisted of the use of unemployment relief funds for highway crossing protective works. Such grants, however, were not restricted by the rules and statutory provisions governing the Fund in order that they could be used to full effect to provide employment. The principal differences being:

- (a) The Board authorized payments out of these special funds, subject to the approval of the Governor in Council.
- (b) They could be applied to existing subways and overhead bridges as well as level crossings.
- (c) Contributions could be made up to 100 per cent of the cost of projects.
- (d) In orders making grants from such funds there were special provisions in regard to wages and working hours of persons employed on the works for which the grants were made.

Seventy per cent became the usual contribution, although in some cases of small municipalities, 100 per cent was paid. The votes were as follows:

1935	\$1,000,000
1936-37	1,000,000
1937-38	1,064,000
1938-39	1,000,000
1939-40	1,000,000

The funds voted to The Railway Grade Crossing Fund are accumulative, whereas the money provided by these special votes had to be committed to projects by the end of the current fiscal year. Payments amounting to \$4,978,192 were made from the special votes.

The Railway Grade Crossing Fund section of the Railway Act in its present form is section 265 as follows:

"265. (1) The sums heretofore or hereafter appropriated and set apart to aid actual construction work for the protection, safety and convenience of the public in respect of highway crossings of railways at rail level shall be placed to the credit of a special account to be known as 'The Railway Grade Crossing Fund', and shall (insofar as not already applied) be applied by the Board, subject to the limitations hereinafter set out, solely towards the cost, not including that of maintenance and operation, of actual construction work for the protection, safety and convenience of the public in respect of crossings (railway crossings of highways or highway crossings of railways) at rail level in existence on the 1st day of April, 1909, and in respect of existing crossings (railway crossings of highways or highway crossings of railways) at rail level, constructed after the 1st day of April, 1909, but the Board shall not apply any moneys out of The Railway Grade Crossing Fund towards the cost of the actual construction work, for the protection, safety and convenience of the public in respect of any existing crossing (railway crossing of a highway or highway crossing of a railway), at rail level, constructed after the 1st day of April, 1909, unless and except an agreement, approved of by the Board, has been entered into between the company and a municipal or other corporation or person by which agreement the municipal or other corporation or person has agreed with the company to bear a portion of the cost of the actual construction work for the

protection, safety and convenience of the public in respect of such crossing (railway crossing of a highway or highway crossing of a railway), at rail level, constructed after the 1st day of April, 1909.

(2) The total amount of money, to be applied by the Board out of The Railway Grade Crossing Fund, under the provisions of this section, in the case of any one crossing, where the cost of the actual construction work in providing the protection, safety and convenience for the public does not exceed one hundred and fifty thousand dollars, shall not exceed forty per cent of such cost, and the total amount of money, to be applied by the Board out of The Railway Grade Crossing Fund, under the provisions of this section, in the case of any one crossing, where the cost of the actual construction work in providing the protection, safety and convenience of the public exceeds one hundred and fifty thousand dollars shall not exceed forty per cent of such cost, and shall not in any case exceed one hundred and fifty thousand dollars.

(3) In case any province contributes towards The Railway Grade Crossing Fund, the Board may apportion, direct and order payment out of the amount so contributed by such province for the purpose of the said fund, subject to any conditions and restrictions made and imposed by such province in respect of its contribution.

(4) In this section 'crossing,' means any railway crossing of a highway, or any highway crossing of a railway, at rail level, and every manner of construction of the railway or of the highway by the elevation or the depression of the one above or below the other, or by the diversion of the one or the other and any other work ordered by the Board to be provided as one work of protection, safety and convenience for the public in respect of one or more railways of as many tracks crossing or so crossed as in the discretion of the Board determined.

(5) The grants or the unexpended portions or moneys thereof made under the provisions of the Acts, chapter 32 of the statutes of 1909, chapter 50 of the statutes of 1914, and chapter 30 of the statutes of 1919, of two hundred thousand dollars each year for twenty consecutive years from the 1st day of April, 1909, may, from and after the 11th day of June, 1928, notwithstanding any provision of any of the said Acts, be expended to aid actual construction work for the protection, safety and convenience of the public in respect of crossings (railway crossings of highways or highway crossings of railways) at rail level in existence on the 1st day of April, 1909, and in respect of existing crossings (railway crossings of highways or highway crossings of railways) at rail level, constructed after the 1st day of April, 1909, subject to the terms and conditions contained in this section.

(6) The sum of five hundred thousand dollars each year for two consecutive years from the 1st day of April, 1949, and the sum of one million dollars each year for six consecutive years from the 1st day of April, 1951, shall be appropriated and set apart from the Consolidated Revenue Fund of Canada to aid actual construction work for the protection, safety and convenience of the public in respect of highway crossings of railways at rail level in accordance with the provisions of this section."

It will be noted that the application of the Fund by the Board is limited in the following respects:

(a) The Fund may be applied only in respect of actual construction work for the protection, safety and convenience of the public at existing

crossings at rail level; it cannot be applied towards the cost of repairing or improving existing subways, bridges or other grade separations;

- (b) It cannot be applied towards the cost of maintenance or operation of works of protection;
- (c) It cannot be applied in respect of protection of level crossings constructed after April 1, 1909, unless there is the agreement mentioned in subsection 1;
- (d) The maximum grant for any one crossing is forty per cent of the cost of construction of the work of protection but the grant may not in any case exceed \$150,000.
- (e) The present appropriation to the Fund is one million dollars annually but there is no appropriation beyond the fiscal year 1956-57.

The Board has ruled that it has no power to order the erection on highways of advance warning signs outside the limits of the railway right of way, and consequently has no power to authorize a contribution from the Fund towards the cost of erecting such signs.

Other Sections of the Railway Act in Respect of Railway-Highway Crossings

The application of sums from The Railway Grade Crossing Fund is only one phase of the Board's jurisdiction and it is appropriate here to indicate in a general way what the Board's powers are in respect of protection, safety and convenience of the public at such crossings.

Sections 258 to 270, inclusive, of the Railway Act are found under the heading "Highway Crossings, etc."

Sections 258 and 259 give the Board power to authorize new crossings of railways and highways and to make such order as to protection, safety and convenience of the public as the Board deems expedient.

Section 260 gives the Board wide powers in respect of existing crossings. Subsection (1) is as follows:

"260. (1) Where a railway is already constructed upon, along or across any highway, the Board may, of its own motion, or upon complaint or application, by or on behalf of the Crown, or any municipal or other corporation, or any person aggrieved, order the company to submit to the Board, within a specified time, a plan and profile of such portion of the railway, and may cause inspection of such portion, and may inquire into and determine all matters and things in respect of such portion, and the crossing; if any, and may make such order as to the protection, safety and convenience of the public as it deems expedient, or may order that the railway be carried over, under or along the highway, or that the highway be carried over, under or along the railway, or that the railway or highway be temporarily or permanently diverted, and that such other work be executed, watchmen or other persons employed, or measures taken as under the circumstances appear to the Board best adapted to remove or diminish the danger or obstruction in the opinion of the Board arising or likely to arise in respect of such portion or crossing, if any, or any other crossing directly or indirectly affected."

Section 261 gives the Board power to order that trees, buildings, earth or other obstruction to the view, that may be upon the railway or the highway, and trees on adjoining land, shall be removed.

Section 262—and section 39 also—gives the Board power to apportion the cost of protection and other works ordered or authorized by the Board. Subject to certain exceptions, the Board may order by what companies, municipalities or persons interested in or affected by such order the cost of construction, operation and maintenance of such work shall be paid.

In determining the allocation of cost, the Board takes into consideration all the relevant circumstances of the particular case and deals with each case on its merits. No mathematical rule of distribution of cost has been laid down by Parliament or the Board. Varying percentages have been ordered by the Board having in mind different facts and circumstances.

The Board has no power to order a province, without its consent, to bear any portion of the cost of protection or grade separation, even although the highway may be under the control of the province.

Section 263 provides that where a railway is constructed across a highway after May 19, 1909, the Company shall bear the whole cost of protection unless and except as otherwise provided by agreement, approved by the Board, between the company and a municipality or other person.

Section 264 gives the Board power to order any railway company to erect foot bridges over its railway at or near highway crossings.

Sections 266, 267, 268 and 269 deal with requirements as to overhead crossings, facilities for traffic at underpasses and overpasses, height of rails above the highway, and the inclination of approach of the highway leading to the railway and protection fences on such approaches.

Section 270 provides for signboards at level crossings and is as follows:

"270. (1) Signboards at every highway crossed at rail level by any railway, shall be erected and maintained at each crossing, and shall have the words RAILWAY CROSSING painted on each side thereof in letters at least six inches in length.

(2) In the Province of Quebec such words shall be in both the English and the French languages."

Section 270 requires only one signboard at each crossing. The Board has made general regulations requiring that the sign shall be painted white with black letters and be so placed as to give the best possible aspect from approaching vehicles, and requiring erection of a sign at each approach where the crossing has three or more tracks.

There are other sections of the Railway Act having to do with safety at highway crossings but the foregoing sections are of particular interest in connection with the problem under review.

III. Accomplishments under the Railway Grade Crossing Fund

The overall record of assistance from the Fund is shown in Tables 5 and 6. Table 5 shows the total expenditure for protection at highway crossings on projects toward which the Fund and other federal votes contributed from 1909 to the end of 1953. Out of a total of \$51,731,255 spent on such projects, Federal Government assistance amounted to \$14,135,839 or 27.33 per cent; the railways' share \$18,297,761 or 35.37 per cent; and that of the provinces and municipalities, for which no further breakdown is available, \$19,297,655 or 37.30 per cent. Costs of protection and the amounts of contributions from

the Fund over most of this period were low by today's standards, but the work accomplished by these expenditures was much greater than could be done at today's cost levels.

Table 6 shows the distribution of Federal aid for grade crossing work by provinces, indicating that approximately 70 per cent of the contribution has gone to work done in the provinces of Ontario and Quebec. While there have never been any explicit directives as to the apportionment of the Fund between provinces, it has been the practice of the Board to obtain insofar as possible an equitable distribution within the limits of its powers of discretion to do so. The fact remains that the grade crossing problem has been most acute in the more heavily populated Central Provinces where the highway systems are the most complete and the number of motor vehicles the greatest.

Table 7 gives the annual record since 1941 of expenditures on grade crossing projects assisted by the Fund.

In addition to expenditures related to the Fund, the railways, provinces and municipalities of Canada spend large sums annually towards the amelioration of dangerous crossing conditions but the amounts of such expenditures are not known. A general summary of post war highway crossing works approved by the Board is given in Table 8. Such projects are the result of applications either by municipal and provincial highway authorities or by the railways, or result from recommendations made by officers of the Board. Grade separations are not included in the projects listed in this Table. It is significant of the trend toward highway modernization that in the "Other" category are included 35 cases of highway widening at crossings.

TABLE 5.—EXPENDITURES FOR PROTECTION AT HIGHWAY CROSSINGS—1950 TO DECEMBER 31, 1953

Province	Railway Grade Crossing Fund	Percentage of Total	Province and Municipality	Percentage of Total	Railway	Percentage of Total	Total
	\$ cts.	\$ cts.	\$ cts.	\$ cts.	\$ cts.	\$ cts.	\$ cts.
British Columbia.....	991,650 92	39.39	970,870 81	38.57	554,765 33	22.04	2,517,287 06
Alberta.....	619,856 00	25.81	1,329,078 27	55.35	452,318 93	18.84	2,401,253 20
Saskatchewan.....	703,115 15	36.50	859,101 86	44.59	364,303 63	18.91	1,926,520 64
Manitoba.....	433,120 93	41.76	248,724 68	23.98	355,360 88	34.26	1,037,206 49
Ontario.....	6,995,008 27	21.53	10,982,156 28	33.80	14,518,900 20	44.67	32,496,064 75
Quebec.....	3,014,256 73	38.94	3,579,905 09	46.25	1,146,418 49	14.81	7,740,580 31
New Brunswick.....	499,316 82	30.64	586,440 66	35.99	543,773 21	33.37	1,629,530 69
Nova Scotia.....	854,763 34	44.06	727,061 54	37.48	358,126 40	18.46	1,939,951 28
Prince Edward Island.....	24,751 41	57.75	14,316 07	33.40	3,794 03	8.85	42,861 51
Newfoundland.....	—	—	—	—	—	—	—
	14,135,839 57	27.33	19,297,655 26	37.30	18,297,761 10	35.37	51,731,255 93

The above figures include payments from The Railway Grade Crossing Fund and all other Votes for highway crossing protection.

TABLE 6.—STATEMENT SHOWING TOTAL AMOUNT PAID FOR WORK DONE IN THE DIFFERENT PROVINCES, OUT OF THE RAILWAY GRADE CROSSING FUND AND SPECIAL VOTES
 Percentage of Total Expenditure in Each Province, and Percentage of Population of Canada in Each Province, from 1909 to December 31, 1953

Province	Total Expenditure from the different Votes	Percentage of Total amount of Expenditure	Population of Province	Percentage of Population of Canada
British Columbia.....	991,650 92	7.02	1,165,000	8.33
Alberta.....	619,856 00	4.38	939,000	6.72
Saskatchewan.....	703,115 15	4.97	831,000	5.94
Manitoba.....	433,120 93	3.06	776,000	5.56
Ontario.....	6,995,008 27	49.48	4,597,000	32.89
Quebec.....	3,014,256 73	21.32	4,055,000	29.01
New Brunswick.....	499,316 82	3.54	515,000	3.68
Nova Scotia.....	854,763 34	6.05	642,000	4.59
Prince Edward Island.....	24,751 41	.18	98,000	.70
Newfoundland.....	—	—	361,000	2.58
	14,135,839 57	100.00	13,979,000	100.00

TABLE 7.—PROTECTION AT HIGHWAY CROSSINGS

Payments made from The Railway Grade Crossing Fund and amount paid by Provinces, Municipalities and Railways, towards the cost,
for the years 1941 to 1953 inclusive

Year	Railway Grade Crossing Fund	Percentage of Total	Municipality	Percentage of Total	Railway	Percentage of Total	Total
	\$ cts.	\$ cts.	\$ cts.	\$ cts.	\$ cts.	\$ cts.	\$ cts.
1941.....	97,327 36	20.76	347,680 58	74.16	23,790 10	5.08	468,798 04
1942.....	16,055 08	38.97	10,914 57	26.49	14,226 84	34.54	41,196 49
1943.....	9,169 86	35.38	8,874 06	34.24	7,874 45	30.38	25,918 37
1944.....	36,131 05	20.48	110,676 21	62.74	29,587 92	16.78	176,395 18
1945.....	29,559 69	39.63	21,355 80	28.64	23,660 33	31.73	74,575 82
1946.....	22,965 08	38.75	13,242 00	22.33	23,070 33	38.92	59,277 41
1947.....	74,961 91	39.44	51,270 58	26.97	63,856 89	33.59	190,089 38
1948.....	95,077 81	39.55	64,603 68	26.87	80,735 47	33.58	240,416 96
1949.....	165,639 36	38.57	148,758 62	34.64	115,008 49	26.79	429,406 47
1950.....	331,719 45	29.50	494,813 88	44.00	298,061 70	26.50	1,124,595 03
1951.....	759,696 03	35.72	688,310 98	32.14	683,312 43	32.14	2,126,319 44
1952.....	478,092 18	25.31	963,609 68	51.00	447,487 65	23.69	1,889,189 51
1953.....	470,996 33	24.12	1,240,048 11	63.51	241,526 31	12.37	1,952,570 75
	2,587,391 19	29.41	4,159,158 75	47.27	2,052,198 91	23.32	8,798,748 85

TABLE 8.—HIGHWAY CROSSING IMPROVEMENTS

1946-1953

Year	New Crossings Approved	Crossings Closed	Highway Diver-sion	Automatic Signals Installed	Improvements to Operating Circuits of Automatic Signals	Sight Lines Established	Other	Total
1946.....	77	19	6	70	23	5	1	201
1947.....	82	24	8	57	29	2	6	208
1948.....	108	18	7	76	33	10	2	254
1949.....	221	58	13	85	15	4	3	399
1950.....	179	41	10	66	25	18	1	340
1951.....	199	39	7	118	20	5	5	393
1952.....	234	24	18	106	42	27	41	492
1953.....	185	26	8	97	46	21	45	428

Referring to the table it may be seen that projects in highway crossing construction and improvement have more than doubled since 1946. The table does not include operating and minor improvements such as advance warning signs or standard crossing signs erected or re-erected and the establishment of speed limitations and train flagging orders.

Another perspective on the progress that has been made over a period of years is obtained by comparing the number of the various types of protection at urban and rural crossings in different years as in Table 9. It will be noted that in urban areas the number of unprotected crossings is still increasing faster than the number of protected crossings but that in rural areas the increase in number of protected crossings has been slightly greater than that of unprotected crossings. To some extent this may reflect the expansion of urban areas and the reclassification of rural crossings as urban.

In 1951, 29.1 per cent of the urban crossings were protected and 6.3 per cent of the rural crossings. The corresponding percentages in 1921 were 28.2 per cent and 4.8 per cent. While this does little to encourage the hope that in the near future the problem can be substantially reduced or disposed of, yet in terms of an annual rate of progress it indicates that in the average year between 1921 and 1951, 27 crossings were protected with automatic signals, 11 by subways, 3 by overhead bridges and at 4 crossings manual gates and at 3 crossings watchmen were replaced by automatic signals. At today's level of costs this would require an annual expenditure of approximately \$6,000,000, which places the accomplishments of the past thirty years in a proper perspective.

IV. Basic Protection at Highway Crossings

The subject of governmental assistance in meeting the costs of protection at highway crossings normally calls to mind projects involving the installation of modern automatic signals or a grade separation. It is these projects, of course, that will obtain the bulk of the assistance provided through the Fund. There are other less elaborate types of protection, however, that have an important part to play in any general program. These include warning signs at and in advance of the crossing, clearing sight lines, improvements to grade and angle at crossings, safety rules for operation of trains and highway vehicles over crossings and similar methods of cutting down the toll of accidents at crossings. This protection might be considered standard for all level crossings since it also would be required in conjunction with automatic signals.

TABLE 9.—NUMBER OF RAIL-HIGHWAY CROSSINGS IN CANADA
BY TYPE OF PROTECTION—SELECTED YEARS

Protection	1921		1931	1941	1946	1951	
	No.	%	No.	No.	No.	No.	%
URBAN							
Gates.....	244	6.1	220	181	184	179	3.3
Bridges.....	210	5.2	237	247	246	254	4.6
Subways.....	311	7.8	435	476	495	523	9.5
Bells and Automatic Signals.....	234	5.9	368	427	441	586	10.7
Watchmen.....	129	3.2	97	82	74	55	1.0
Total, Urban Protected.....	1,128	28.2	1,357	1,413	1,440	1,597	29.1
Total, Urban Unprotected.....	2,873	71.8	3,481	3,635	3,684	3,883	70.9
Total, Urban.....	4,001	100.0	4,838	5,048	5,124	5,480	100.0
RURAL							
Gates.....	79	.3	45	15	18	20	.1
Bridges.....	336	1.4	333	383	380	388	1.4
Subways.....	405	1.7	502	533	529	524	1.9
Bells and Automatic Signals.....	303	1.3	420	610	643	761	2.9
Watchmen.....	28	.1	5	7	9	6	—
Total, Rural Protected.....	1,151	4.8	1,305	1,548	1,579	1,699	6.3
Total, Rural Unprotected.....	22,826	95.2	25,430	25,366	25,378	25,433	93.7
Total, Rural.....	23,977	100.0	26,735	26,914	26,957	27,132	100.0
Total, Protected.....	2,279	—	2,662	2,961	3,019	3,296	—
Total, Unprotected.....	25,699	—	28,911	29,001	29,062	29,316	—
Grand Total.....	27,978	—	31,573	31,962	32,081	32,612	—

Such methods, while they are not foolproof or as effective in particular situations as more expensive types of protection have two important advantages, viz: low cost and the fact that wherever one or a combination of them are used to their best advantage at a crossing they may give sufficient protection to all motor vehicles whose drivers are prepared to use all reasonable precautions. This is not to say that the more expensive installations into which most of The Railway Grade Crossing Fund contributions have gone are required solely because of carelessness or negligence at crossings. Traffic conditions on the highway today introduce new risk factors which affect all drivers. High speed is one and would justify a carefully planned system of standard advance warning signs. Another element of risk arises from heavy streams of traffic on a highway where cars may follow one another for miles at a similar speed. In such cases, there is a tendency to relax caution on the assumption that if the car ahead is moving along steadily it would be safe to

follow him and be governed by his action. At a railway crossing, however, the line must break and the driver must have warning in time that he must wait while the car ahead may safely clear the crossing.

High speed and poor visibility are also accident causes that might be greatly reduced in effect by speed restrictions, advance warning signs, flood-lighting of crossings or reflectorizing of signs and the sides of railway cars. In 1953 there were 487 grade crossing accidents of which 221 or 45 per cent occurred at night. Of the accidents in which motor vehicles were involved, the breakdown between day and night accidents indicates the added risks of night driving:

Motor Vehicles hit by train	Accidents	Killed	Injured
Day	166	57	215
Night	118	67	149
	<hr/> 284	<hr/> 124	<hr/> 364
Motor Vehicle ran into side of train			
Day.	59	22	68
Night	98	19	175
	<hr/> 157	<hr/> 41	<hr/> 243

Inability to stop in time or inability to see probably account for most of the accidents where motor vehicles run into the sides of trains, the speed factor being more important in daylight and the visibility factor more important at night. Actually, if the difference in traffic volume between day and night could be taken into account, the night accident rate would probably exceed that for daytime.

During the course of its investigation the Board received numerous suggestions for protective devices at crossings from different sources both at public hearings and in correspondence, which bore evidence of the widespread interest in this matter. Not all such suggestions met the test of practicability applied by those most conversant with all aspects of the problem, but it is significant that many of the suggestions did not call for costly installations but were concerned with different types of relatively simple signs and indicators in attempts to improve upon those now in use. We feel that there are great possibilities for improvement along these lines, not that present warning signs are unsatisfactory, but that newer types may be devised which for very little extra cost would give much more effective protection. As we have already pointed out it would be a mistake to assume that the expenditure of many millions of dollars on automatic signals or on grade separation projects is the only possible way of reducing the toll of highway crossing accidents. While much more must be done in this direction it is important that experiment and research be continued in extending and improving the less costly types of warning devices at crossings.

Of the various suggestions received by the Board those which appear to have the greatest merit and warrant further investigation include:

- (1) Railway crossing signs indicating the angle of the crossing.
- (2) Floodlighting of certain crossings.
- (3) All warning signs to be reflectorized.
- (4) Placing strips of luminous tape or paint on sides of railway equipment.

- (5) Crossings particularly dangerous by reason of poor visibility or other reasons to have highway stop signs.
- (6) Advance highway warning signs of various types: e.g. pavement markings, reflectors etc.

Not all of the above suggestions need be adopted at all crossings, but by careful selection one or more of the above methods might prove efficient ways of reducing crossing accidents at lower cost than the installation of standard automatic signs. Best results would doubtless be achieved with methods that could be used selectively, thus cutting down the total costs of installation and maintenance. Thus, while the installation of reflectorized warning signs at crossings would be an improvement, if it were done too rapidly at all crossings throughout the country the cost might well constitute an undue burden in any given period of time. The same applies to the application of reflector tape on all railway equipment. Such newer types of protection could be installed progressively as existing ones require replacement for any reason which would spread the financial burden of the changeover over a period of years.

As to the advance warning signs to be used, this is a matter for which the provinces and municipalities are primarily responsible. Under today's traffic conditions they are almost indispensable but the Board has no authority to require the erection of such signs by the provinces or municipalities and the applicability of the Fund has been limited to improvements at crossings.

Highway speed restrictions at crossings or in the vicinity of dangerous crossings might give good results. A requirement that highway traffic stop at all railway crossings would be too rigid and hampering and would be difficult to enforce. However, 20-miles-per-hour zones within a certain distance on either side of level crossings, similar to those required by certain provinces on their highways might well be enforced in all provinces.

V. Level Crossing Protection

Level crossing protection in this report refers to any method of protection short of eliminating the crossing itself by means of road or rail diversion or grade separations.

Over the years a wide variety of protective devices and methods have been tried out. This is indicated in Table 10, which enumerates by types the crossing protection projects assisted by The Railway Grade Crossing Fund from its inception until December 31, 1941, at which time work practically ceased for the duration of the war.

Many of the foregoing forms of protection have been found inadequate and have been replaced by more modern types of protection and others are being replaced as need arises. The Board is aware of the many technological advances stemming from research and development towards more effective protection, particularly in the electric and electronic fields. A continuing study is being made of all worthwhile developments. At present automatic signal installations have been reduced to two principal types: the automatic flashing light and bell, and the automatic flashing light and bell with short-arm gates. There are numerous variations of these to fit conditions at particular crossings, but it could safely be said that any program for the future will be concerned mainly with these two types. As will be apparent from the above table, the most frequently used form of automatic signal up until about ten years ago was the familiar bell and wigwag. Modern driving conditions, however, have brought out the superior value of the flashing lights, which are more conspicuous than the wigwags.

TABLE 10.—PROTECTION OF HIGHWAY CROSSINGS UNDER THE RAILWAY GRADE CROSSING FUND FROM APRIL 1, 1909, TO DECEMBER 31, 1941

Description	Number
Automatic Interlocking Plants	14
Electric Bell	182
Electric Bell and Flashlight	7
Electric Bell and Wigwag	713
Electric Bell, Wigwag and Gate Arm	10
Electric Flashlight	1
Easing Curve on Approach to Bridge	1
Gates	120
Gates, Automatic	3
Gates, Electric	2
Gates and Half Interlocker	1
Improvements to Grade on Crossing Approach	18
Change Ringing Circuit of Bell	4
Lightning Flash Signals	12
Open Two Level Crossings In Lieu of Replacing Bridge	1
Reflectorized Crossing Signs	3
Shelter (watchman)	1
Removing Obstructions to View and Reducing Grade	6
Removing Obstructions to View	171
Floodlights	4
Wigwags	7
Tower (watchman)	3
Total	1,284

Where the railway is double-tracked at crossings, the most effective form of automatic signal protection is by short-arm gates and flashing lights. The gates extend over the road to block the on-coming lanes only, so that cars on the crossing are not trapped by the lowering of the gates. More important from a safety angle is the fact that when trains are approaching in opposite directions the gates remain down until both trains have passed. A frequent cause of accident at double-track crossings protected only by flashing lights is the inability of this signal to indicate that a second train is approaching once the first train has activated the signal.

A summary of the types of protection installed in the years 1948-1953 with the assistance of The Railway Grade Crossing Fund is given in Table 11:

TABLE 11.—NUMBER OF PROJECTS APPROVED FOR CONTRIBUTIONS FROM THE RAILWAY GRADE CROSSING FUND

Type of Protection	1948	1949	1950	1951	1952	1953
Two or more flashing lights and bell	57	59	48	89	84	76
Automatic short-arm gates and signals	4	3	5	12	12	7
Miscellaneous automatic signal changes	9	4	8	3	3	10
Improving grade of approaches	—	—	5	—	10	6
Improving sight lines	7	3	10	5	15	15
Total	77	69	76	109	124	114

Average Costs

Some conception of average costs of the two types of automatic signals at present being installed at crossings may be gained from the data derived from the operations of The Railway Grade Crossing Fund, which is described in Tables 12 and 13.

TABLE 12.—INSTALLATIONS OF TWO OR MORE FLASHING LIGHTS AND BELLS
The Railway Grade Crossing Fund 1952

Group	No.	Total Estimated Cost	Average Estimated Cost
Under \$ 2,000.....	2	700	—
2,000 — 2,999.....	2	4,762	—
3,000 — 3,999.....	2	7,543	—
4,000 — 4,999.....	12	53,788	—
5,000 — 5,999.....	21	116,251	—
6,000 — 6,999.....	12	77,401	—
7,000 — 7,999.....	12	87,613	—
8,000 — 8,999.....	8	67,200	—
9,000 — 9,999.....	6	56,350	—
10,000 — 10,999.....	3	31,250	—
11,000 — 11,999.....	2	22,700	—
Over 12,000.....	2	30,800	—
	84	556,358	6,628

TABLE 13.—INSTALLATIONS OF AUTOMATIC SHORT ARM GATES AND SIGNALS
The Railway Grade Crossing Fund 1952

Group	No.	Total Estimated Cost	Average Estimated Cost
Under \$10,000.....	2	13,800	—
10,000 — 10,999.....	1	10,112	—
11,000 — 11,999.....	2	22,530	—
14,000 — 14,999.....	1	14,000	—
17,000 — 17,999.....	1	17,000	—
18,000 — 18,999.....	1	18,350	—
21,000 — 21,999.....	1	21,500	—
22,000 — 22,999.....	1	22,028	—
Over 23,000.....	2	47,050	—
	12	186,370	15,531

Comparisons of the above estimated costs with the actual costs incurred for those installations for which final figures are available indicates that estimated costs are, on the average, about 8 per cent above actual costs. In round figures this would indicate for the year in question an average actual cost for flashing light and bell signals of \$6,100 and for automatic short-arm gates and signals an average cost of about \$14,200. As these tables indicate, there is a wide range of costs on individual projects, and the data for the automatic short-arm gates are probably insufficient to indicate in any but a most casual way the average costs of a typical installation.

A number of individual projects were also investigated to study the major components of the costs. In the cost estimates for flashing lights the labor costs ranged from 17 per cent to 31 per cent of the total; cost of materials imported

from the United States ranged from 37 per cent to 49 per cent; and total material costs ranged from 64 per cent to 82 per cent of total estimated costs. From the data examined the average ratio of the main charges would appear to be about 30 per cent labor, 35 per cent United States materials and 35 per cent other costs.

Included in the costs of United States materials were duty ($22\frac{1}{2}$ per cent) and sales tax (10 per cent). The latter charge was also present in the costs of Canadian materials. The removal of the tariff on railway signal equipment effective April 6, 1954, reduces the costs of imported equipment appreciably. For the typical flashing light installation the saving should run in the neighbourhood of \$500.

Advantages and Limitations of Protective Devices

The advantages and limitations of the two modern types of crossing protection devices may be briefly summarized.

(a) Flasing lights and bells

1. A fixed railroad crossing sign is provided.
2. They are not subject to damage by highway traffic.
3. They provide a visible and audible signal beginning not less than twenty seconds before the train's arrival at the crossing.
4. For multi-track installations the warning signals continue to operate after the passage of one train, if another is approaching on a second track.
5. A high degree of protection is provided for an average capital cost of \$6,100 and an average annual maintenance cost of \$560.
6. When highway traffic is of moderate density, they probably represent maximum crossing protection at the least cost.

These devices do, however, have certain limitations, including:

1. The twenty second warning period when the crossing is "clear" of a train is an inducement for some motor vehicle drivers to ignore the warning. This appears to be particularly true with drivers who are most familiar with the particular crossing.
2. In multi-track installations there is no positive bar to prevent vehicles proceeding across the track after the passage of one train but before the arrival of the second train.

(b) Short-Arm Gates

1. Flashing lights (and bells) operate at the same time and independently of the gates which descend 3 to 5 seconds after the warning signals start to operate.
2. The horizontal position of the gate arm is both a warning and a positive deterrent to traffic.
3. When applied to multi-track installations the warning signals continue to operate and the gates remain in the horizontal position after the passage of one train if another train is approaching on a second track.
4. If the circuits should become "out-of-order" the gates assume a horizontal position.
5. Three red lights are provided on the gate arms of which two are flashing lights and so spaced that no vehicle can obscure all three lights from a following vehicle.

6. The maximum degree of level crossing protection is provided at an average cost of \$14,200 and an average annual maintenance cost of \$865.
7. For many crossings the device is best suited to the topography, the traffic volume and financial resources and will continue to be so for some time.

They also have certain limitations, including:

1. Their comparatively high cost justifies their installation only at crossings of particularly hazardous nature, or as an alternate to grade separation.
2. Maintenance costs are a substantial and continuing item which increase proportionately with the number of installations.

Protective Suggestions Received by the Board

During the course of our investigation we received many suggestions respecting the expansion and acceleration of crossing protection installation. While a number of specific suggestions were made, ranging from protection at one crossing to as many as five or six, the majority of submissions stressed the national aspect of the matter. In general the contentions were that the unprotected crossing must be eliminated; that rural and urban crossings are critically inadequate in terms of present day traffic and should be brought up to a satisfactory standard; and that a progressive program for protecting all major crossings should be undertaken.

Although it may be desirable to eliminate all grade crossings we must, of necessity, view this in a practical manner. In the first place we, and in fact the majority if not all of those who appeared before us, recognize that limited public and railroad funds and competition from demands for other desirable undertakings preclude the elimination of level crossings within any short span of years.

In the second place such an approach to the problem fails to distinguish between "preventable" and "non-preventable" accidents, and unless such distinction is made funds will be spent in an inefficient and uneconomic manner. Some accidents may occur because motor vehicle drivers are not adequately warned that a train is approaching or standing in a crossing. Other accidents may occur because the protective devices at the crossing are inadequate. Accidents of these types could be largely prevented by the installation of improved warning and protective devices.

There are other accidents, however, which occur at grade crossings and which may be directly attributable to excessive motor vehicle speed, mechanical defects in motor vehicles, and the human factor which impels grade crossing users to take chances or otherwise disregard their own safety. Accidents of these types may be termed "non-preventable" in terms of any signalling device and are the responsibility of the motorist. While no form of protection can positively prevent their occurrence, a stricter enforcement of highway traffic laws would doubtless diminish their frequency. Funds of the government or the railways should no more be spent for protection against such accidents than for other measures which would prevent persons from endangering their own safety through the improper use of private property. It is the protection of crossings to eliminate preventable accidents which must be the principal concern in considering the grade crossing problem.

Effectiveness of protective devices

Conditions being different at almost every crossing it is not easy to measure the relative effectiveness of the different types of protective devices particularly where they are used in combination. Carelessness operates at random and affects the safety record of all types of protection. It could even be said that the better the highway and more elaborate the protective installation the greater the tendency of some motorists to relax even ordinary precautions at crossings and assume that no danger exists. Since crossing protection devices tend to be installed at the more dangerous crossings, the accident record at such crossings is not comparable with that at unprotected crossings.

To obtain precision in safety ratings it would be necessary to develop an index that would reflect such different factors as the volume and speed of highway and rail traffic, daily fluctuations in traffic volume using the crossing, weather conditions, locational factors peculiar to the crossing which might affect the safety of the crossing and so forth. These would have to be combined to produce a homogeneous risk factor by which different crossings could then be subjected to a common standard of comparison.

The Board has not found it essential to its purpose to develop any such elaborate statistical methods, if only for the reason that the task of measuring traffic would be almost insuperable even for only a few selected crossings, and it would be difficult to develop reliable generalizations. The report of the Highway Committee, Signal Section, A.R.E.A., concludes that "a satisfactory formula for universal use in determining the relation hazards at grade crossings cannot be developed".

Reference might be made, however, to a study of this problem conducted by the Wabash Railroad. An analysis was made of accidents on the railway by type of protection covering the period 1929-1948, and adjustments were made for changes in accident potential resulting from changes in traffic volume and other known factors. An "accident quotient" was calculated for each type of protection, the results being summarized in Table 14.

TABLE 14.—WABASH RAILWAY 1929-1948 FINAL ACCIDENT QUOTIENTS

Class	Type of Protection	Final Accident Quotient	Calculated Accident Rate one accident per crossing every
Visual and/or audible indication of the approach or presence of train on crossing.	Automatic Gates.....	0.0925	Years
	Manual Gates—24 hours.....	0.1513	10.8
	Flashing lights—single track.....	0.1773	6.6
	Wigwag.....	0.2036	5.6
	Flashing lights—multiple track.....	0.3044	3.5
	Manual Gates—part time.....	0.3520	3.3
	Watchman.....	0.3581	2.8
	Automatic bell.....	0.3941	2.8
			2.5
Indicate Location of Track or Tracks.	Crossbuck reflector—A.R.E.A.....	0.4450	2.2
	Crossbuck—Painted.....	0.5038	2.0
	Crossbuck reflector—Michigan.....	0.8156	1.2

The above table offers a scale of effectiveness of the different types of protection which might be interpreted somewhat as follows: for every accident at a crossing protected by automatic gates there would be 2 accidents if the same crossing (single track) had been protected by flashing lights, or 3·3 accidents if the same crossing (double track) had been protected by flashing lights. Unprotected, there would have been 9 accidents over the same period. In other words, substitution of flashing light protection at single track crossings for the ordinary standard crossbuck warning sign could be expected to reduce the number of accidents by approximately 78 per cent. However the matter cannot be determined solely on the basis of such percentage figures, since the absolute amount of risk at each crossing and the relative costs of the different methods of protection must also be considered.

Grade Crossing Protection Benefits

That benefits to the public, particularly communities and motor vehicle users, result from the installation of crossing protection devices is so obvious and so widely accepted that no occasion exists for us to elaborate on this aspect. It need only be noted that altogether apart from economic loss, on humanitarian grounds alone there is a case for protecting hazardous level crossings.

The case of railway benefits from crossing protection are a somewhat different matter. It has been urged upon us that the railways receive substantial benefits from crossing protection, particularly in respect to savings from accident claims, repairings trains and right-of-way equipment and facilities, operating delays and loss of public goodwill. Undoubtedly the railways would be in a position to receive benefits from such savings where protection is installed. On the other hand, were protection to be undertaken at a large number of new locations, the capital and maintenance costs incurred by the railways might quickly exceed the total cost of accidents including property damage. From the random nature of crossing accidents it is apparent that some crossings may remain accident free for many years. As crossing protection becomes more general the financial benefits of new installations to the railways will decrease. This must be borne in mind, since the benefits related to the railways' experience in grade crossing losses as a whole differ from the benefits related to selected crossings.

VI. Grade Crossing Separation Projects

This category includes a wide variety of projects differing greatly in cost and size but linked by the common factor of the elimination of a level crossing.

The main difficulty in discussing this class of projects is that there is even less in common between individual projects than in the case of level crossings. With automatic signal installation at level crossings there is only the differences in traffic volume and crossing approaches to be taken into account. With grade separation or crossing elimination, in addition to the traffic volume, there are such other factors as topography, soil conditions and drainage, highway and rail approaches, expropriation of adjacent property, or compensation for damage to that property, and the overall costs.

Up until 1941 the number of the various projects in this class which had been aided by grants from The Railway Grade Crossing Fund was 699, and the breakdown of this figure is given in the following table.

TABLE 15.—ELIMINATION OF HIGHWAY CROSSINGS UNDER THE RAILWAY GRADE CROSSING FUND

From April 1, 1909 to December 31, 1941

Description	Number
Closing Crossings*	266
Crossings Eliminated	111
Diversion and Overhead Bridge	15
Diversion and Subway	11
Diversion to Subway	4
Footbridge	1
Overhead Bridges Reconstructed	5
Overhead Bridges	120
Pedestrian Subways	5
Subways	146
Subways Reconstructed	14
Tunnel	1
Total	699

*There were 291 Highway Diversions constructed, which made it possible to close 266 crossings and eliminate traffic from 111 crossings.

A summary of the main types of separation or elimination projects since 1948 is given in the following table.

TABLE 16.—NUMBER OF PROJECTS APPROVED FOR CONTRIBUTIONS FROM THE RAILWAY GRADE CROSSING FUND

Type of Elimination	1948	1949	1950	1951	1952	1953
Subways	1	3	2	1	5	5
Overhead Bridges	—	—	6	2	5	4
Diversion of Highway	1	2	1	2	—	3
Diversion of Railway	—	—	—	1	—	—
Total	2	5	9	6	10	12

The number of overhead (highway) bridges and subways at crossings in Canada was reported in 1951 as:

	Bridges	Subways
Urban	254	523
Rural	388	524
	642	1,047

Average Cost

In drawing up a program of grade crossing protection or elimination, the lack of suitable average cost figures is a handicap in predicting the probable achievements as well as the limitations of such a program. For automatic signals, as has been seen, a reasonable average could be derived although the range of costs was still wide. Table 17 shows the number and estimated costs of grade separation or elimination projects assisted by The Railway Grade Crossing Fund in the five years 1948-1952.

TABLE 17.—GRADE CROSSING ELIMINATIONS APPROVED
THE RAILWAY GRADE CROSSING FUND 1948-1952

Type of Elimination	No.	Estimated Total Cost	Average Estimated Total Cost
		\$	\$
Subways receiving 40% aid from G.C.F.	6	1,288,140	214,690
Subways receiving maximum aid.....	6	5,285,760	860,960
Overhead Bridges receiving 40% aid from G.C.F.	11	1,175,250	106,841
Overhead Bridges receiving maximum aid.....	2	1,175,000	587,500
Diversion of highway, 40% aid from G.C.F.	6	446,370	74,395
Diversion of railway, 40% aid from G.C.F.	1	35,000	—

The particular projects in each of the above groups are not sufficiently numerous or similar to one another to provide reliable average costs. The lower cost groups of subway projects ranged from \$78,000 to \$350,000, whereas the highest estimated cost subway project was \$2,100,000. Overhead bridges ranged in cost from \$40,000 to \$725,000. Highway diversions ranged from less than \$1,000 to \$220,000.

Because of this lack of uniformity in conditions we are of the opinion that detailed analysis of the costs of such projects would have little practical value. Nevertheless, we are faced with the problem of arriving at an average cost so that we may be able to make some estimation of the probable amount of work that can be done under the particular program which we are prepared to recommend. From an examination of the costs of individual projects there seems to be a clear cut division in type as regards cost between urban and rural projects, the reasons for which are fairly obvious. It would appear that urban costs, and for this purpose subways and bridges could be taken together, have averaged around \$800,000 per project. Rural projects, on the other hand, have averaged around \$100,000 per project.

Advantages and Limitations to Separations

Provided that the structures are of sufficient width, clearance and weight carrying capacity, the accident and traffic problems of the level crossing are solved by grade separation. The careless motorist is protected against crossing hazards; the railway benefits from crossing accident elimination, savings in signal maintenance, relief from certain speed and operating restrictions and by the possibility of installing additional trackage; and the community at large may be benefited through residential, industrial or metropolitan development and integration.

Topographical conditions may be a final determinant in the practicability of installing either subway or overhead projects. The cost of some overhead projects appear low enough (\$40,000) to warrant their consideration as a practical

alternative to automatic protection. In addition thereto, it may be possible to construct some overheads without the necessity of moving all of presently installed public utility services.

The Demand for Grade Separation Projects

The Board received many general and specific suggestions respecting the undertaking of separation projects.

The general suggestions were to the effect that where topographic conditions are suitable the Board should install separation structures rather than protective devices; that a definite policy of providing separations on all provincial and national highways should be undertaken; and that over a period of time grade separations should replace existing grade crossings.

The specific suggestions usually related to the provision of separation projects within city limits and usually for the prime purpose of either reducing or eliminating a traffic congestion problem. For instance, the City of Edmonton contended that within the next 5 years 5 separations at an estimated cost of \$6,300,000 must be undertaken, and within 12 years at least 12 separations would be necessary; the City of London referred to eleven railway-street crossing bottlenecks, for which the capital cost of improving would approximate between \$8,000,000 and \$9,000,000; the City of Toronto estimated that the cost of eliminating 38 level crossings would approximate \$60,000,000; the City of Quebec favoured a project of railway relocation which would eliminate many level crossings within the city, but with no estimate of the costs; the Province of New Brunswick referred to 5 hazardous grade separations which presented a serious problem for today's traffic; the City of Moncton proposed the elimination or improvement of 13 level crossings; the City of Halifax requested correction of "the Fairview bottleneck" together with removal of the hazards at certain main line and siding crossings; the Province of Nova Scotia favoured grade separations and stated that the topography generally lends itself to this type of undertaking, and the Province of Prince Edward Island suggested that four of 257 rail-highway crossings could be classified as grade separation undertakings.

The high cost of grade separation projects in comparison to the number of accidents at crossings where separations are requested clearly indicates that the demand is only partly for reasons of safety. While it is true that instances may occur where protection other than separation would still contain a hazard, yet the great majority of separation applications obtain substantial justification on other grounds. Population growth, urban development, amongst other things, create a way of life which places a relatively high value upon motor vehicle service. As a higher value is placed upon motor vehicle service, so higher costs are readily incurred in order to permit maximum use of motor vehicles. Grade separation constitutes one of several means of achieving this end, because highway capacity is raised by the removal of the restrictions to the free flow of highway traffic which are unavoidable at level crossings.

The demand for grade separation projects is primarily a demand for improvement in the free flow of highway traffic by eliminating the stops, delays and traffic congestion which may occur at grade crossings; only secondarily is it a demand for crossing protection. Otherwise, maximum protection could be provided by installing protective devices at substantially lesser cost, for while grade separation represents the most complete form of protection, in most cases it also represents the highest cost protection.

Justification for Grade Separation

Our experience in dealing with applications for separation projects, representations made to the Board in the course of the hearings, and a careful study of the matter all lead us to the conclusion that no one basic rule can be applied

to determine the need for a grade separation. This results from the fact that while benefits from grade separation are economic in nature they are not susceptible to precise measurement in monetary terms. While one must acknowledge the difficulties inherent in any attempt to evaluate the economic benefits with exactness, yet we are of the opinion that, to the extent possible, the benefits must be measured and compared with the costs of the project. Only in this way do we believe that separation projects will be provided where they will return the greatest value for the expenditure in accordance with prudent financial management.

There are very broad general conditions under which grade separations, rather than protection, would, other factors being equal, appear warranted.

1. Grade separations may be provided as adjuncts of the construction of "super highways" which intersect railway rights-of-way. In these cases separation is necessary if the highway is to fulfill its primary purpose of permitting maximum traffic movement with maximum safety. Here justification for the separation is merged with justification for the highway itself. Benefits of the separation are inseparable from the benefits to be derived from the highway, and the separation costs are part of the total highway costs.

2. Grade separations may be provided where the inherent accident hazard of a crossing is extremely high and cannot be removed at a cost less than that of separation.

3. Grade separations may be provided where the inherent accident hazard is relatively high and where the crossing location is such as to minimize the costs of adequate protection.

4. Grade separations may be provided where the topography of the site justifies the project. In some situations, it may be uneconomical to protect a crossing at grade and comparatively inexpensive to build a bridge or underpass.

While conditions in the foregoing cases would generally indicate separation rather than protection as the solution, they are not typical of conditions at the majority of crossings where separations are sought. At these latter crossings highway or railway traffic, or both, are of such volume that the resulting stops, delays and congestion of traffic call for some form of remedial action, but as the funds available are not unlimited, these are the cases which it is necessary to evaluate most carefully before a project is undertaken.

It would appear that in the evaluation of grade separation benefits, certain benefits are considered as accruing to the general public. These usually include improvement in the economic development of communities, enhanced values of residential and industrial property, a more orderly economic development, and other similar beneficial results. Where it can be reasonably ascertained that any of such benefits do accrue to the general public then they constitute partial justification for grade separation. There would seem however to be numerous cases where the benefit is not an overall public benefit in this sense. The effect of traffic congestion caused by grade crossings, for instance on business sales, is probably no greater than the effects of inadequate parking facilities, inadequate street capacity, and the fact that there has been, until recently, an overwhelming tendency for businesses to locate in congested areas. The location of industries, commercial establishments and low-cost housing near railway tracks has more to do with the demand for and supply of real estate than it has with the existence of grade crossings. Where grade crossings may block the movement of essential community services, such as fire and police protection, the real answer in many cases may be dispersal of these services rather than grade separation.

A grade separation may, or may not, contribute benefits to a railroad. If the grade separation is economically justified, and if the railroad's share of the investment cost is equal to the capitalized value of the railroad's benefits,

then the separation project will not alter the railroad's economic position. If, however, the separation is justified on a convenience or welfare basis, and if the railroad's share of the investment cost exceeds the capitalized value of the railroad's benefits, then the separation project would adversely affect the railroad's economic position.

The principal benefits accruing to railroads from grade separations are of two types. The first type includes those which result from accident prevention; the second, where a separation relieves the railway of operating and maintenance costs of a protected crossing. Both of these types of benefit are reasonably determinable and may serve to indicate the railway's economic interest in the grade separation projects. Operating benefits occur where a grade separation permits removal of certain speed restrictions or ends the necessity of flagging of train and switching movements or breaking of standing trains. Where grade separations are made at or near yards there are reduction of delays, greater freedom in switching and placing of cars, and in some cases additional trackage may be put in that would not be practicable at busy level crossings.

Undoubtedly the best and only complete answer to the grade crossing problem is the grade separation. But so long as the costs remain so high, both in absolute amount and in relation of benefits at less dangerous crossings, the cases where the grade separation is the logical solution must remain exceptions to the general rule. Where parties are either unwilling or incapable of bearing their share of the costs of separations there is every reason to settle for less costly means of protection.

VII. What a Grade Crossing Protection or Elimination Program Involves

By our terms of reference we are required to report on the methods considered by us to be practicable under all pertinent circumstances of eliminating the hazards and improving the public convenience and the protection and safety of the public at highway grade crossings. For us this involves an examination of different possible programs of action in which the Federal Government could participate through The Railway Grade Crossing Fund to achieve these long-term objectives.

The best overall picture of the grade crossing problem can be obtained by using an example of a large-scale program. In working out the details of this program we have relied heavily on concepts such as the "typical crossing", and the "average cost" of different types of protection.

While such assumption may be open to objection if applied to small samples, the results of using them in large samples such as the hypothetical large-scale program given here need not be considered unrealistic, since a suggestion of the total amounts likely to be involved is sought rather than precision in details.

In the survey of highway crossings undertaken by the Board to which reference has already been made, crossings were classified according to certain main characteristics, viz: type of protection, type of road surface, class of road, class of railway. Using the data obtained from this survey we have been able to draw up a comprehensive, or long-term program which will serve for purposes of illustration.

This consists of three separate aspects:

(1) The six unprotected crossing groups having the highest accident frequencies as indicated in Table 3 are assumed to be protected by automatic flashing lights. We have earlier said that the average cost for such protection could be assumed to be about \$6,100. However we have raised this figure

to \$7,000, to account for the probability that some of these crossings would normally be protected by automatic short-arm gates and flashing lights which is a more expensive installation.

No.	Type of Road Surface	Class of Road	Class of R.R.	No. of Crossings	Accident Frequency per 100 Crossings per year
1	Paved	Prov. Hwy.	Main	88	13.0
2	Paved	Urban	Main	230	9.9
3	Paved	Rural	Main	208	6.9
4	Paved	Prov. Hwy.	Other	582	6.3
5	Gravel	Urban	Main	202	5.5
6	Gravel	Prov. Hwy.	Main	114	4.0
				1,424	

(2) The seven automatic-signal protected crossing groups having the highest accident frequency are assumed to be replaced by grade separations. Average costs here mean very little because no two projects are the same. No account could be taken of the fact that a grade separation project frequently involves more than one crossing and may permit closing of more than one existing crossing. However, in order to arrive at an overall figure it was assumed that grade separations in rural areas would average \$100,000 and in urban areas \$800,000. The total figures may not be too far from reality in spite of wide variation in individual cases. The groups in this category were:

No.	Type of Road Surface	Class of Road	Class of R.R.	No. of Crossings	Accident Frequency per 100 Crossings per year
1	Paved	Urban	Main	243	8.0
2	Paved	Rural	Main	182	6.4
3	Paved	Prov. Hwy.	Main	155	5.5
4	Paved	Urban	Other	318	5.3
5	Unimproved	Rural	Other	7	4.1
6	Paved	Prov. Hwy.	Other	253	4.0
7	Paved	Rural	Other	117	3.3
				1,275	

(3) Five classes of crossings are now protected with gates. As all had relatively high accident frequencies it was assumed that grade separations were made in these cases also:

No.	Type of Road Surface	Class of Road	Class of R.R.	No. of Crossings	Accident Frequency per 100 Crossings per year
1	Paved	Rural	Main	6	9.5
2	Paved	Urban	Main	87	8.0
3	Paved	Urban	Other	64	5.6
4	Paved	Prov. Hwy.	Main	7	4.1
5	Gravel	Urban	Main	4	3.6
				168	

Table 18 indicates the provincial distributions by number of crossings and estimated costs of the improvements assumed to be undertaken. It is not suggested that the above crossings are necessarily the ones that should be selected for inclusion in the program, or that the type of protection assumed to be provided at these crossings is in every case the proper one. The above basis of selection does however, give a reasonably clear idea of the implications of embarking on a wholesale program of protection or elimination of grade crossings.

Such a program as had been outlined here, involving an estimated cost of \$655,468,000 at today's level of prices and wages very clearly indicates the magnitude of such an undertaking. Even if spread over a period of 20 years, this program would involve an annual expenditure of nearly \$33,000,000. At the end of that period only at some 1,433 crossings or less than 5 per cent of the total number, would the problem have been eliminated by the construction of separations. It does not seem to us to be within the realm of possibility that an annual program of this size could be supported without causing a heavy diversion of expenditure from other projects of equal or greater urgency to all participating parties. Against the benefits of such a program must be set not only the actual costs but also the alternative opportunities for dealing with highway safety and other undertakings that would have to be foregone if the program were adopted. We have not ventured to make any comparisons between the value of a grade crossing program and other possible projects, but we can hardly fail to recognize the grade crossing problem as but one of many that are of concern to the people of Canada today.

From time to time suggestions have indeed been made that the grade crossing problem should be attacked in the most complete fashion, that the people of Canada should undertake what might be called a "grade crossing bee" within the next few years in order to dispose of the matter swiftly and permanently. We believe that there are many good reasons why such a policy should not be adopted, of which the more important are:

(1) The total cost would be completely out of line with the probable benefits. The hypothetical program given in this section would involve over \$650,000,000 expenditure and would affect less than 10 per cent of all crossings in Canada.

(2) The benefits of such a program would have to be considerable to warrant an expenditure of this magnitude, and from latest available statistics it would appear that less than 1 per cent of all highway traffic accidents would be affected by it. There are other useful and necessary projects requiring assistance which might rank ahead of so large a program of grade crossing protection or removal.

(3) A grade crossing program must necessarily be a cooperative program. Federal Government funds could not be expected to contribute the entire financial support for the program. A very extensive program would undoubtedly strain the resources of the railways and municipalities and of most of the provinces, so that a result of the program might be that the money was spent in areas where it was least needed, since no differential scale of Federal contributions according to need would seem practicable.

(4) A heavy program would mean a heavy demand on the engineering and technical staff of the railways and the provincial highways departments as well as the municipalities, which might be a limiting factor to the amount of work that could be attempted.

(5) The effects on grade crossing programs of possible relocation or removal of railway lines and highways could only partially be allowed for, if speed in construction were the chief aim of the program. In all parts of Canada today plans are being made to cope with the ever growing problem of highway traffic. In many cases a radical rearrangement of both rail and highway routes is already planned, but in almost every case new through roads, by-passes and express ways

are proposed. As these plans are carried out many highway crossings will be affected, traffic will be diverted from several crossings, new grade separations will be made at others and some will be eliminated entirely. In our view, to superimpose on these carefully planned long range projects a large grade crossing removal program for immediate execution would create much confusion, and would not be conducive to the most efficient use of the funds. It is obvious that future highway projects will greatly alter the hazard at particular crossings in different ways depending on how they are affected by the resulting diversion of traffic.

We are, therefore, of the opinion that assistance to a grade crossing program should not outstrip any of the many general plans for dealing with highway reconstruction and relocating but should be capable of being co-ordinated with them whenever they are ready to be proceeded with.

TABLE 18.—SUMMARY OF ILLUSTRATIVE GRADE CROSSING IMPROVEMENT PROGRAM
By Number of Crossings

Nature of Work Done		Canada	B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	N'fd.
Unprotected to Automatic Signals.....		1,424	131	97	101	82	559	300	90	46	16	2
Autom. Sig. to Separations.....		561	24	15	11	19	313	112	27	34	5	1
Urban.....		714	35	14	4	8	387	143	61	54	7	1
Rural.....		1,275	59	29	15	27	700	255	88	88	12	2
Sub-Total.....												
Gates to Separations.....		155	4	4	2	4	95	35	3	7	1	—
Urban.....		13	—	—	—	—	5	5	—	3	—	—
Rural.....		168	4	4	2	4	100	40	3	10	1	—
Sub-Total.....												
Total.....		2,867	194	130	118	113	1,359	595	181	144	29	4
Percent.....		100	7	5	4	4	47	21	6	5	1	—
By Estimated Costs (000 omitted)												
Unprotected to Automatic Signals.....		9,968	917	679	707	574	3,913	2,100	630	322	112	14
Autom. Sig. to Separations.....		448,800	19,200	12,000	8,800	15,200	250,400	89,600	21,600	27,200	4,000	800
Urban.....		71,400	3,500	1,400	400	800	38,700	14,300	6,100	5,400	700	100
Rural.....		520,200	22,700	13,400	9,200	16,000	289,100	103,900	27,700	32,600	4,700	900
Sub-Total.....												
Gates to Separations.....		124,000	3,200	3,200	1,600	3,200	76,000	28,000	2,400	5,600	800	—
Urban.....		1,300	—	—	—	—	500	500	—	300	—	—
Rural.....		125,300	3,200	3,200	1,600	3,200	76,500	28,500	2,400	5,900	800	—
Sub-Total.....												
Total.....		655,468	26,817	17,279	11,507	19,774	369,513	134,500	30,730	38,822	5,612	914
Percent.....		100	4	3	2	3	56	20	5	6	1	—

VIII. Financial Responsibility of Municipalities and Provinces

A brief review of the distribution of general responsibilities and revenue sources of the municipalities and provinces is a prerequisite to the consideration of financial responsibility in specific grade crossing projects.

Governmental functions in Canada are divided between three classes of governmental bodies, the Federal Government, the Provincial Governments and the municipalities of various kinds. The British North America Act, 1867, assigned certain specific matters to the Federal Government, together with general authority over all matters not specifically placed under provincial jurisdiction. Certain other specific matters were assigned to the provincial governments, together with those matters of a strictly provincial or local nature. Municipal acts, later passed by the provinces, delegated certain functions which could best be handled by local authorities to the municipalities.

Paralleling the assignment of responsibilities was the allotment of specific fields of taxation. Originally the Federal Government received revenue largely from customs and excise duties; the provinces received a federal subsidy, the proceeds from the lease, rental or sale of public lands and the proceeds from direct taxes, fees, licences and permits; the municipalities obtained their revenues largely from property taxes.

Over the years changes became necessary, largely because of the inadequacy of provincial revenues. Federal allowances to the provinces were increased and by 1900 the provinces were also levying income taxes, poll taxes, real and personal property taxes, succession duties and corporation taxes. Still later came provincial gasoline taxes, automobile registration fees, amusement taxes and liquor profits.

Developments subsequent to the depression have greatly favoured provincial revenues but have not brought corresponding relief from municipal financial difficulties. Since municipal revenues are almost entirely derived from taxation of real property, the inflationary trend forced heavy increases in tax rates. The municipalities, however, had to do more than keep pace with the rising costs of their existing commitments. Expansion has been taking place in urban municipalities throughout the country, bringing with it demands for new roads, sewers, watermains, schools, hospitals and other local improvements. At the same time the maintenance of roads and streets under municipal control has been growing more onerous. Without revenues derived from the automobile industry or highway traffic, the municipalities have acquired heavy new responsibilities which, unless outside assistance is obtained, must be met from their general tax rates. Today city streets must have snow removed so that traffic may flow normally, rural roads must be plowed during the winter. Pavements are required on city streets and main rural roads, and heavier pavements are required where traffic is greatest. Such costs of construction and maintenance of municipal roads and streets are a substantial burden on the municipalities.

Somewhere in this last item is included the cost of grade crossing protection, both construction and maintenance. It will be apparent that municipalities, in view of these existing demands on their resources, are in no position to give a general priority to grade crossing projects. Already provincial financial assistance is helping them meet urgent needs in road building and in other fields. Left to their own resources, together with the railroads' contribution and the grants from The Railway Grade Crossing Fund the municipalities would be able to undertake only those most urgent improvements at grade crossings where traffic congestion and accident hazard have become extreme.

It seems clear from the foregoing, and in our hearings we found a general acceptance of this conclusion, that municipalities must receive financial aid from provincial governments to carry their share of the cost of projects even

if an expanded Federal contribution is eventually made. Otherwise many important projects would have to be postponed indefinitely and a serious limitation would be placed on the effectiveness of any expanded grade crossing program.

Apart from the financial problem, the view that most municipalities are forced to take on any large grade crossing project such as a grade separation results in it receiving a low priority. For a municipality such a project is a capital undertaking of some size and must be compared with a new school or the servicing of a new street. For the province, on the other hand, the crossing project is generally considered as part of a highway program and comprises a much smaller part of the total roads expenditures than in the case of the municipality in which the project is located. This puts the project in a different perspective, for the province will include it in its general appraisal of highway expenditures as opposed to other expenditures, and makes the decision merely one of how much highway funds should be spent on crossing projects.

Municipalities, without exception, reported to the Board that they cannot bear their share of the cost of necessary crossing projects. The reasons for this contention are simple: (1) costs of projects have been subject to the general inflation, (2) many of the projects now necessary are far beyond the standard considered adequate a few years ago, and (3) that the rise in educational, public works and social service expenditures has outstripped the increase in municipal tax revenues. In this connection it is significant to note that, from 1939 to 1951, both federal and provincial taxes increased considerably beyond municipal taxes. Generally the municipalities hold that, as the federal and provincial taxes take such a large part of the people's income, it is almost impossible to consider even a moderate increase in municipal taxes—and particularly when the priority of a grade crossing project is less than other public works which the municipalities are under heavy pressure to undertake. In addition, while the general level of wages and incomes has increased, the increase of property owners' incomes has not been equally distributed.

The Board has heard the suggestion that the financial problems of the municipalities would be alleviated if the Provincial Governments were to share with them the proceeds of the gasoline tax. While this is a matter entirely within provincial jurisdiction, yet, because it was suggested that such sharing might be a means enabling municipalities to carry out their local highway and grade crossing projects, it is deserving of some comment. In our view, however, this would not constitute a desirable means of financing such projects. Not only do we doubt that a workable formula could be devised for the sharing of the tax proceeds, but more important we doubt that the payments would adequately reflect the relative needs of the various municipalities. We are of the opinion that the present practice, whereby the provinces retain the proceeds of the gasoline and other taxes and aid the municipalities in such amounts as they feel the project justifies, is the more suitable.

Present Provincial Aid to Municipalities

Grade crossing projects are highway projects and the extent of provincial assistance to municipalities in this matter can best be gauged by noting the extent of assistance now given for highway projects.

Our information shows that there is no uniformity in the manner in which such assistance is given. There are in the first place differences in the way in which responsibility for the upkeep of the road systems in the provinces are divided between the provinces and the municipalities. In the Atlantic Provinces, the general situation is for most roads outside of incorporated cities and towns to be directly under the control of the provincial government. In other provinces, the governments assume direct control only over the main system of trunk highways, sharing with municipalities in certain cases the

responsibility for some secondary highways. In the second place, the extent to which the different provinces commit themselves to aid the municipalities varies. Even in cases where statutory provision has been made for assisting the municipalities, the discretion of the Minister of Highways appears to be a decisive factor. The fact would seem to be that the provincial governments are prepared to extend financial assistance when and to the extent that their resources permit, but avoid incurring any fixed obligation which could not be varied according to circumstances.

In our view an effective grade crossing program requires no standardization in such matters, but may even be better served by the greater freedom and flexibility of the present arrangements. More important is the fact that we found an unanimous desire to expedite such a program, and the co-operation proffered appeared to us as generous having regard to the resources available.

IX. The Allocation of Costs

While a grade crossing project provides benefits to motor vehicle users, the railroads and the general public, yet the benefits are not the same for each of these groups, nor will it usually result that a group will obtain the same share of benefits from different crossing projects. For this reason, the relative demands of the individual groups for crossing protection will seldom, if ever, be the same in any given circumstance. In fact, it is more likely, and experience shows this to be the case, that a proposed crossing project will bring out some conflict of interest between the parties. This conflict of interest reflects the fact that each party has a different balance of benefits and costs on each project.

Present Basis of Cost Allocation

Section 39 of the Railway Act, which empowers the Board to assess the cost of any works on its order, including that of rail-highway crossing protection or improvement, reads as follows:

39. (1) "When the Board, in the exercise of any power vested in it, in and by any order directs or permits any structure, appliances, equipment, works, renewals or repairs to be provided, constructed, reconstructed, altered, installed, operated, used or maintained, it may, except as otherwise expressly provided, order by what company, municipality or person, interested or affected by such order, as the case may be, and when or within what time and upon what terms and conditions as to the payment of compensation or otherwise, and under what supervision, the same shall be provided, constructed, reconstructed, altered, installed, operated, used and maintained."

(2) "The Board, may, except as otherwise expressly provided, order by whom, in what proportion, and when, the cost and expenses of providing, constructing, reconstructing, altering, installing and executing such structures, equipment, works, renewals, or repairs, or of the supervision, if any, or of the continued operation, use or maintenance thereof, or of otherwise complying with such order, shall be paid. R.S., c. 170, s. 39."

It is not difficult to note in the above sections of the Act, and in Section 265 which deals with the Fund, that the issues they were intended to provide for were originally much less complex and less important than they are today. With few exceptions, the light volume of highway traffic of fifty years ago

required a standard of adequacy in protection considerably less than that of today. The cost liability for protection was correspondingly lower and could reasonably be assumed by the junior party, whether railroad or municipality. Maintenance charges were also light and seldom constituted a burden. In fact, the relatively small cost of reasonably adequate protection had the effect of minimizing many contentious points and parties accepted responsibility for small costs because they seemed trivial in amount. In later years, however, the demands for protection or elimination of crossing hazards grew, as well as the costs themselves, so that all parties scrutinized more carefully the principles involved, and what had previously been accepted without protest became subject of dispute.

The basic rule of assessing costs of works ordered by the Board has been the senior and junior rule, whereby the party that is junior in right at any new crossing must sustain the costs of protection when the crossing is opened. While this rule can be applied with some consistency in regard to new crossings, where the need for protection has obviously been caused by the junior party, it is of less value in allocating costs of protection at existing crossings and other principles must be relied on. This is because at existing crossings it must be assumed that adequate protection has been installed at some previous time to the satisfaction of the Board, and if it later ceases to be adequate it must be due to new factors for which the junior party is not necessarily responsible. In such circumstances, it has been the usual practice of the Board, in apportioning the cost, to divide the balance, after a grant of 40 per cent from the Fund, equally between the interested parties.

In recent years, however, this practice has been subject to some qualification. Efforts have been made to distinguish between protection required by reason of increased traffic on the highway or on the railway, and where this is the case, the share of the cost on the other party has been reduced and sometimes eliminated.

The Theory of Cost Allocation on a Benefit Basis

The demands of beneficiary groups for improved transportation service, including therein protection, give rise to the demands for grade crossing projects. If such projects are to be economically justified, then account must be taken of the benefits each group will derive from the project, and the relative dollar values which may be attached to these benefits become the basis for distributing the costs of the project among the beneficiary groups. The capitalized value of the economic benefits expected to be received by a beneficiary group would fix the maximum cost allocation to the group, and each group would bear a portion of the burden in direct relation to the benefits it would receive.

While the benefit principle is a relatively new approach to grade crossing projects, it has been used by the Board in several cases dealing with grade separations. We are also aware that it is widely used in the United States for crossing projects on the federal highway system, as well as by several State authorities. It combines flexibility with generally accepted standards of equity and is in accord with economic principles. In our opinion, the benefit principle does provide one objective means of distributing crossing project costs among interested parties.

Proposals submitted to the Board regarding Distribution of Protection Project Costs

In considering the practical application of the benefit principle, we must recognize certain factors which bear directly upon the whole problem of crossing protection. In the first place, the benefit principle, in itself, cannot rectify a situation where one of the beneficiary groups may not be able to bear its thus determined share of the cost. This problem exists today under the usual percentage distribution of costs; it would become more acute if the group unable to bear its share today were held to be the chief beneficiary for its share of the costs would thereby be increased. Secondly, that while within the limitations of fixed funds on the one hand and increasing costs of protection on the other it may be concluded that crossing protection has kept pace with the crossing problem, yet it is certainly true that the procedure has not reduced the problem. It appears to us that what is needed is a broad general principle concerning benefits that could be applied throughout the country, and which permits a realistic approach to these fundamental problems. A painstaking effort to apply the benefit principle to each and every proposed crossing project would involve a lengthy and laborious process to make even slight progress, and would defeat the purpose of an expanded program.

The Canadian National, which favours a benefit principle, has submitted that the Board, in order to eliminate the delay and expense associated with strict application of this principle, might establish a formula fixing the shares of the railway and highway authorities on the basis of the average case and then apply the formula whenever satisfied that a particular installation was economically justified and did not depart far from the average case. The Canadian National proposed that in protecting existing level crossings the railway's share should be fixed at 10 per cent of the cost of the protective work, this percentage to represent the railway's benefit therefrom. In the case of new level crossings, and in the absence of "traffic flow" statistics, there should be a trial period of one year to determine whether or not protection is required. If during the trial period it is established that protection is required, the costs should be borne by the party responsible for opening the crossing. Cost of protection later required at such a crossing should be allocated on the basis of the standard benefit formula.

From a practical standpoint, the Canadian National proposal has much to commend it. It is also in general agreement with the procedure adopted by the United States Bureau of Public Roads. That Bureau, in setting forth railway contributions under various circumstances, stated:

"Experience has demonstrated that it is impossible to measure benefits satisfactorily for individual railway-highway projects. In consequence many projects have been delayed because of prolonged negotiations concerning benefits, therefore, as a practical operating procedure the railway contribution shall hereafter be determined by classes or types of railway-highway projects."

Many of the parties appearing before the Board made submissions which, directly or indirectly, indicated what share of the costs they believed should be borne by the railways. While these percentages cannot be directly compared with those suggested by Canadian National, due to the fact the items entering into each are not always the same, yet it is generally indicated that the railway's share might be between 25 per cent and 15 per cent of the total cost, and possibly less in some cases. While this might be taken to mean that other parties consider that the railway's percentage share should be reduced

from the present 30 per cent, it must be borne in mind that these reduced percentages followed submissions that the Fund should assume a substantially increased percentage share.

In fact, some confusion is likely to occur in speaking of percentage shares of total cost and the use of the benefit principle if the share of the Fund, which is not based on benefit, is not kept distinct from the others. At the present time, the Fund share is 40 per cent, subject to a maximum contribution of \$150,000 for any single project, and the railways and highway authorities most frequently share the remainder of the cost equally; that is, each meets 30 per cent of the total cost. Referring to the allocation of only that part of the costs subject to the benefit principle, the proportions would be 50 per cent each. It is this equality of benefit between rail and highway that modern highway traffic conditions are increasingly calling into question.

The Canadian National proposed that the Fund should bear 70 per cent of the cost of approved projects, which, taking into account its proposal that the rail share should be 10 per cent, would leave 20 per cent to be borne by the highway authority. This would indicate a benefit principle of \$2 of highway expenditure for \$1 of rail expenditure.

Allocation of Funds for Grade Crossing Work

We have found unanimous opinions among those making representations on the subject that the maximum proportion contributed by the Fund should be increased. In many cases this was accompanied by a recommendation that no absolute limit be set on the contribution of the Fund to any one project.

The Canadian National recommended that the contribution from the Fund be raised to 70 per cent and that no maximum be set on the contribution to individual projects. The Canadian Pacific asked that at least 70 per cent come from the Fund and the elimination of any restriction on the amount for individual projects.

Five provincial governments, either directly or by inference from other recommendations, favoured increases in the proportion of the cost to be borne by the Fund and the raising or elimination of the present restriction of \$150,000 on single projects. Two provinces recommended a contribution of 60 per cent with a maximum of \$300,000 on single projects. One province recommended a contribution of 60 per cent on grade separation with maintenance costs to be assumed by the province or municipality, and a contribution of 80 per cent on automatic signals protection with maintenance costs to be borne by the railways; a second favoured 75 per cent with the limit on single projects raised to \$300,000; while a third also favoured 75 per cent but with no limitation on single projects.

Of those municipalities which offered suggestions on this subject, the majority were in favour of raising both the percentages and the maximum but without specifying actual figures. One municipality, however, recommended that the percentage contribution of the Fund be raised to 75 per cent; another recommended that the Fund contribute 60 per cent on minor projects and up to 80 per cent on major separation projects, and that the limit of contributions to single projects be raised to \$500,000.

Other submissions generally recommended both increasing the percentage contribution from the Fund and the limit on single projects. The most conservative of these submissions advocated a 50 per cent maximum share and no change in the present \$150,000 limit on single projects.

We find ourselves in agreement with the views generally expressed that the percentage contribution from the Fund should be increased. Our actual experience is that a principal factor limiting expansion in the number of grade crossing projects is the limited funds that railways and highway authorities can make available for such work. It would, therefore, be impractical to consider increased federal support without at the same time providing for increased participation in individual projects.

The two major classes of projects for which the Fund is used are crossing protection and grade separation. We will consider these separately as there are certain differences in principle which we believe should be observed in the allocation of costs.

A. Grade Crossing Protection

The present maximum share of the cost that can be borne by the Fund is 40 per cent, and was first established in 1926. While most of the representations made to us advocated increases in the percentage share of the costs to between 60 per cent and 80 per cent, we cannot overlook the fact that the views of other contributing parties, whatever their merit, represent only one aspect of the whole problem—the need to relieve these parties of some of the burden of costs of protection. On the other hand, we must also take into consideration the appropriate and economical use of federal monies. Doubtless there are many rival claims for federal support and it is to be assumed that the federal authority would be loath to divert more money than is clearly and equitably justified into grade crossing work. Neither can we ignore the importance of leaving sufficient financial responsibility to the other co-operating parties as will encourage them to make the most efficient use of their own contribution where the need is greatest. We are strongly of the opinion that the retention of the economic motive by all parties is the best guarantee against wasteful use of funds.

It appears to be undeniable that if appreciable progress is to be made in the elimination of crossing hazards the Federal Government must accept, subject to a limitation on a single project, a major share of the cost. In the first instance, it is the Federal Government which can best meet the national aspects of the problem.

Secondly, the assumption of an increased share of the costs by the Federal Government serves to minimize the financial inequalities which exist as between individual provinces and between individual municipalities. Moreover, many of the problems as we have found them to be are not entirely the responsibility of a municipality or province because of the fact that national aspects are often factors in the matter.

While the railways have an interest in crossing protection and obtain benefits therefrom, yet these benefits are usually not large. The best indication of this difference in benefit is the fact that most applications for assistance are initiated by the municipalities or the provinces when they are prepared to make the expenditure that would represent their share. Without assurance that municipalities are able to finance a project either on their own or with provincial assistance the project would never reach the Board. In the nature of the case, projects initiated by the railways of the type that are eligible for grants from the Fund are relatively few, and generally arise as a part of changes in track layout. Recognizing this as the situation today, it would be illogical to contemplate an equal division of costs between railway and highway authorities. Nor would it be reasonable to assume that the railways

could match the total contributions of ten provinces and numerous municipalities from coast to coast in any extended program of crossing protection. As between the two parties there are differences in responsibility, benefit and ability to pay.

We are convinced that no impartial study of the present-day problem could fail to recognize that the greater benefit from rail-highway crossing projects occurs to the highway users. The changing factor today is the level of highway traffic for rail traffic conditions do not vary to a comparable extent. On this basis, it would seem that a fair division of responsibility would be obtained by the respective highway authorities assuming a major share of the costs. As a practical matter, however, we are compelled to recognize that not only are there appreciable variations between the financial positions of the various authorities but also that the problems, whether they be municipal or provincial, vary in both degree and extent.

Having regard to the representations made and to a reasonable distribution of the costs in a manner reflecting differences in responsibility, benefits and ability to pay, we are of the opinion that the costs of crossing protection might be shared on the basis of 60 per cent by the Fund, 25 per cent by the highway authority, whether provincial, municipal or both, and 15 per cent by the railway; and that the amount available from the Fund be subject to a limitation of \$300,000, on any single project.

It cannot be too strongly emphasized, that in recommending this distribution for the normal case the Board is not seeking to limit its discretion in particular cases, whether by statute or precedent. Such a rule is justified by the great similarity in the numerous protection cases which come before us and for the most part these are relatively small projects with few complicating factors insofar as benefits are concerned. In addition thereto it would enable the various parties to estimate in advance their probable commitment on one or many projects; it would do away with much repetitious argument in particular cases and thus expedite the actual work on the project; and it would offer a starting point for deciding upon any differing basis of benefit, the onus of showing how a particular case diverged from the normal would be upon one or other of the parties involved.

In recommending that the ratio of rail to highway contributions be 15 per cent to 25 per cent of total costs, as compared with the present usual ratio of 30 per cent to 30 per cent of total costs, we have in effect provided that the Fund assume 50 per cent of the burden now falling on the railways and $16\frac{2}{3}$ per cent of the burden now falling on the municipalities and provinces in the normal case. This result seems to us a fair and practical way of applying additional federal assistance. It has already been pointed out that the grade crossing program had been subject to the limitations of railway and municipal resources. The railways can probably expect no assistance from the provinces or any other source in making what for them are largely non-economic expenditures, and if their benefit is to be adjudged smaller under modern conditions, it is a necessary condition to further progress in grade crossing protection that the part of the burden no longer to be assessed against the railways be assumed by another party. We have concluded that such a responsibility is peculiarly one for the Federal Government, and that the increase in the percentage of costs met by the Fund would be a recognition of that responsibility. At the same time, as has been noted, we find it possible to recommend that the Fund provide some relief from the burden now assumed by the highway authorities. In this way the essential impetus can be given to a more vigorous approach to the grade crossing problem than it has heretofore received.

B. Grade Separation

Consideration of the determination of a fair assumption of the costs for grade separation projects brings forth factors which if not absent in the consideration of crossing protection projects are at least of a different character.

It is evident that a grade separation can be a very expensive undertaking. It is equally evident that the benefits of separation will more largely accrue to highway users than to the railways, and if the costs of separation are shared on a benefit basis the major burden would fall upon the highway authorities. As a practical matter this raises identical problems to those of crossing protection, with the added difficulty that the cost here under consideration will usually exceed by many times the cost of protection. Here again the highway authority with the most acute problem may well be the one least able to assume the financial burden.

While the great majority of the proposals made to the Board did not differentiate between "protection" and "separation", it may generally be concluded that the same percentage contribution by the Fund would apply towards both types of undertaking. In particular, the recommendations as to increasing, or abolishing, the presently existing maximum of \$150,000 would thereby permit the Fund to assume a larger share in separation projects. The Canadian National, on the other hand, recommended that the railway's share of the costs be determined on the basis of benefits received by the railway. Presumably the remaining costs would be distributed between the highway authority and the Fund.

We feel that the problem of "separation" justifies our taking a somewhat different view than that which we take of "protection". Separation is usually called for in cases where conditions have outgrown existing protection. It may arise in connection with the reconstruction of an existing highway to a higher standard. It is not usually a matter which comes quickly into prominence but rather whose probable development can often be known sometime in advance. Just as the highway itself may remain a long time in the planning stage, so the separation project can be the object of a long-term plan.

Upon careful consideration of the many aspects of the matter, it appears to us that the Fund must be liberalized to assume a greater share in the costs of separation undertakings. If the Fund were to assume 60 per cent of the capital cost with a maximum of \$300,000, it would appear that provinces and municipalities would be in a better position to plan, over a series of years, for justifiable grade separation projects.

We do not think it desirable to predetermine the manner in which separation costs would be shared by other parties for in our experience each separation constitutes an individual project having its own peculiar conditions. A fixed ratio would therefore have little practical value and might prove seriously misleading to the interested parties trying to estimate their probable share of the costs. Each project, because of its size should be examined on its merits, and nothing could be assumed as to probable distribution of costs, other than that in the majority of cases the benefit principle would likely require that the greater part of the costs be considered the responsibility of the highway authority.

X. Annual Contribution to the Railway Grade Crossing Fund and Conditions of its Use

When Parliament amended the Railway Act to provide for the establishment of the Railway Grade Crossing Fund the original grant was set at \$200,000 annually. In 1948 the grant was increased to \$500,000, and in 1951 further

increased to \$1,000,000. In addition thereto, the government paid \$4,978,192 out of unemployment relief funds for highway crossing protection during the years 1930-31 and 1935-40, and a special vote of \$500,000 was made towards a grade separation project in the City of Hamilton.

As a matter of record at this point it might be informative to summarize the Fund allocations and the estimated total capital cost for the years 1952 and 1953, as follows:—

	1952	Fund Allocations	Estimated Total Capital Cost
2 Urban Separations	\$ 300,000	\$2,990,000
8 Rural Separations	550,780	1,377,000
92 Automatic Signals	296,431	741,000
		<hr/>	<hr/>
Contributions of other parties	\$1,147,211	\$5,108,000
		<hr/>	<hr/>
	1953	Fund Allocations	Estimated Total Capital Cost
3 Urban Separations	\$ 450,000	\$1,303,000
6 Rural Separations	578,960	1,347,000
82 Automatic Signals	262,828	657,000
		<hr/>	<hr/>
Contributions of other parties	\$1,291,788	\$3,307,000
		<hr/>	<hr/>
			2,015,000

Without exception, parties appearing before us in the course of this investigation have contended that the annual contribution of the Federal Government to the Fund should be increased. While many parties proposed that the contribution should be increased "substantially" or "considerably", other parties recommended that the federal contribution should be "approximately \$4,000,000", "\$5,000,000", "\$10,000,000", "\$20,000,000" and "\$30,000,000". In no case, however, were definite reasons given in support of any particular amount.

In face of this unanimity of opinion and the recognized concern of the Federal Government itself with the grade crossing problem as evidenced by its directive to the Board to undertake the present investigation, it would require reasons of great weight to oppose a liberalization of these particular terms of the Fund. We have had sufficient evidence presented to us during the course of our investigation to indicate that a considerable expansion in the aid provided through the Fund is well justified.

In attempting to determine what might be the annual federal contribution to the Fund, we recognize that while it cannot be determined with mathematical precision, it must reasonably reflect the practical aspects of the matter. Any amount which may be arrived at we think should also be sufficiently flexible in character to admit of modification in the light of actual experience. It would be difficult to justify a federal contribution which was not in reasonable accordance with the availability of highway authority funds. Certainly it would be uneconomic to cause a diversion of highway funds to grade crossing improvements in an amount which was not commensurate with the magnitude of the crossing problem. At the same time an increase in the contribution of the Federal Government, when related to the percentage distribution of costs as hereinbefore recommended would necessarily result in increasing the total potential costs to other parties—and regard must be had to the increased costs which the other parties may be economically justified in assuming. Furthermore, while we are aware that some provinces have sufficient funds to enable them to undertake a sizeable crossing improvement program, we cannot use their preferred position as a criterion of what other provinces may be able to undertake.

Having regard to these and other factors, we have endeavoured to outline in broad terms what would appear to be a reasonably practicable approach to the problem on a national basis, bearing in mind our expressed views as to the desirability of concentrating efforts to the maximum possible degree at this time on protection rather than separation projects.

In considering the many aspects of the matter for which no factual answer can presently be provided, as well as acknowledging that the program which we contemplate is a new one with which we do not have the benefit of actual experience, we would recommend that the annual grant be increased from \$1,000,000 to \$5,000,000. It would seem desirable at the same time to prevent money accumulating in the Fund if for any reason the normal rate of activity in grade crossing projects remained below the available resources in the Fund. This might be done by providing that until otherwise determined Parliament would vote \$5,000,000 annually or such amount as to bring the uncommitted portion remaining in the Fund to \$7,000,000, whichever was the lesser. In proposing this contribution we are not unaware of the several representations made to us that the Fund should be "flexible", nor of the advantages of flexibility. Although the Fund may give a lead in the matter of grade crossing protection—and we believe this to be a proper function of the Fund—it is admittedly difficult to determine how quickly the annual contribution may be expended for much depends upon provincial action and cooperation. The sum which we now propose cannot be regarded otherwise than an estimate of probable demands on the Fund under the new conditions. It may well be two or three years before the most effective amount of the annual appropriation can be more definitely fixed. It should be pointed out that such a grant would not represent the full extent of the aid given by the Federal Government on highway construction, nor would it preclude further assistance on specific projects which may have some connection with highway crossing protection. It represents in our view the extent to which the said Government on balance should initially commit itself to assist projects falling within the scope of the Fund, liberalized as we shall subsequently recommend.

The effect of raising the Fund's participation in individual new projects is that its share will be increased by 50 per cent on all projects up to \$375,000 in total cost. For projects costing between \$375,000 and \$500,000, the increase in its share of total costs will vary from 50 per cent to 100 per cent as the cost approaches \$500,000 due to the raising of the maximum contribution from \$150,000 to \$300,000. On projects over \$500,000, the Fund contributions would be doubled.

A very broad assessment of the overall effect may be made on the basis of new projects only. Raising the annual grant from \$1,000,000 to \$5,000,000 would increase the value of projects that could be undertaken without exceeding the maximum on single projects from \$2,500,000 to \$8,333,333. Larger expenditures are possible but they would have to be borne entirely by other parties. If the new grants were fully utilized, the combined expenditure of railways and municipalities would increase from \$1,500,000 to \$3,333,333, not including additional expenditures required on projects costing over \$500,000. In other words, under these conditions the Fund contributions would be increased to five times, other parties' combined contribution to 2.2 times and the overall expenditures to 3.3 times their present level.

It is our considered opinion that a program of these proportions would represent the maximum amount of use of the Fund grants at this time, and that any attempt initially to carry out a larger annual program would be subject to several objections: (1) the additional financial aid from the Federal Government would necessarily be applied to less urgent projects, and the value of the projects

relative to other types of expenditure would be less; (2) as long as the grade crossing program remains a co-operative one—and we are strongly of the view that it should so remain—an expansion of federal grants without regard to the ability of other parties to finance their share would either cause an unwarranted strain on railway or municipal finances or leave a certain portion of the available grants unused; (3) apart from financial and economic limitations, there are also limitations of skilled labour, engineering personnel, equipment and similar items to be considered. Even on the program which we have suggested, we are not assuming an adequate supply of these factors will always be on hand.

It will be noted that the expanded program if fully carried out would mean higher contributions from other parties. In other words, the increasing of federal grants from 40 per cent to 60 per cent of the cost of projects will be more than offset by the larger number that will be undertaken if the full \$5,000,000 in grants is to be used. In grade separation projects the maximum single contribution from the Fund would be \$300,000, but the total cost of a single major project might be as high as \$2,000,000. Were there no limitation on the amount of the grants to a single project, the contributions of 60 per cent would require \$1,200,000 from the Fund. We have considered the implications of this question, and in recommending a maximum of \$300,000 per project have sought to avoid having the greater part of the Fund applied to a few large projects. The sum of \$900,000 which is the difference between the full 60 per cent and the maximum of \$300,000 would provide a large measure of protection if distributed over many projects in different parts of the country.

The above considerations point clearly to the greater part which provincial governments may play in the work of grade crossing protection. In the course of our investigation we have been impressed by the evidence that the railways and the municipalities are neither in a position to take on greatly increased commitments for grade crossing work. In fact, this situation, in varying degrees of intensity, has been at the heart of the grade crossing problem from the beginning and is responsible for the original establishment of the Fund. On the other hand, we have noted a willingness on the part of at least some of the provinces to increase their assistance in this matter, even if only to the extent of assuming some of the burden now falling on the municipalities. However, not all provinces find themselves in a position to expand their efforts on grade crossing work, so that we have had to have regard to the particular terms that are laid down for obtaining grade crossing grants to avoid a system in which the benefits of the grant would flow largely to areas where the financial need was least.

We believe that the recommendation of a limitation of \$300,000 on single projects will offer the best solution to this aspect of the problem. This means that on the large grade separation projects which are not eligible to receive the full 60 per cent grant from the Fund by reason of the maximum limit of such grants, a proportionately greater share of the cost will fall on the provinces and municipalities directly concerned. It appears to us that such large projects, where the highway traffic problem is almost invariably a major factor, offer a natural field for greater provincial participation in grade crossing improvements, permitting a greater part of the federal contribution to go to projects where safety and protection are the more important factors. We are aware of the already considerable efforts of the provinces towards eliminating crossing hazards through building many grade separations on new highways entirely at their own expense. Yet we must also bear in mind that once a proper scale of federal aid has been arrived at, the benefits of that aid will be more widespread and effective by being distributed over many smaller or medium-sized projects where the

protection rather than the convenience of the highway users is the paramount factor. In this way, too, the provinces will be able to adopt programs commensurate with their resources.

It should be made clear that the Board has no jurisdiction over provincial governments in this matter. The Board is therefore powerless to enforce any selection of projects in any one year unless those projects in which willingness to proceed has been indicated happen to create demands on the Fund in excess of its current resources. In such cases the Board would be obliged to select those projects which would receive grants from that year's appropriation. Because of the generally uncoordinated way in which applications have been received in the past, the only possible basis of selection has been priority in time in most cases.

It is possible that a somewhat different situation would exist if our proposals herein are put into effect, since we have envisaged a prior survey of requirements in each of the provinces possibly specifying in advance the projects to be undertaken over a two or three year period. We are hopeful that the co-operative procedures on which the general progress of the work so largely depends can be extended to the final determining of priorities as much as possible. In other words, the Board, as in other matters that arise in dealing with this problem, would prefer to act as much as possible in accord with the concensus of opinion, and has every confidence that general principles of selection acceptable to all parties can be arrived at as the need may arise with the result that the benefits to be derived from the suggested increase in contribution from the Fund may be equitably distributed throughout Canada.

Improvement or Reconstruction of Existing Grade Separations

Section 267 of the Act provides that every structure by which any railway is carried over or under any highway, or by which any highway is carried over or under any railway, shall be so constructed and maintained as to afford safe and adequate facilities for all traffic passing over, under or through the structure. While the existing structure may be perfectly safe and have a long service life ahead, changed highway traffic conditions may necessitate its improvement, or even reconstruction. Under the present provisions of the Act, the Board is unable to make a contribution from the Fund and the entire cost of such improvement or reconstruction must be borne by other parties.

Whatever may be the benefits to the railway and to the highway authority of such improvement or reconstruction, it would be difficult to deny that they assumed some share of the costs which could more equitably be apportioned to other beneficiaries. At the same time, however, cases of this nature are essentially modernization undertakings designed to increase the capacity of the existing structure in relation to the increased highway capacity. While the structure may be obsolete from a capacity standpoint, the fact remains that even in its present form it does provide complete protection against rail-highway accidents. In comparison with cases having either no protection or inadequate protection, these improvements or reconstruction cases would therefore appear to warrant a lesser priority than other possible undertakings. We believe that the economic justification of a contribution from the Fund and the lesser priority of such undertakings might both be reasonably reflected by permitting the Fund to make a contribution of 30 per cent of the cost of improvement or reconstruction up to a maximum of \$150,000, the remainder of the costs to be distributed on a benefit basis.

Highway Diversion

It has also been proposed that the present limitation, whereby the Board is unable to authorize a grant from the Fund unless an existing crossing is eliminated, should be removed. While this limitation probably sought to bring about the closing of old crossings as new ones were opened, highway traffic today has sufficiently changed as to warrant consideration of whether certain exceptions may not now be permitted in the case of a grade separation.

Cases arise where it is economically justified to divert highway traffic from an established route to a new route. The location of the new crossing may, however, be such that people residing in close proximity to the old crossing would be severely inconvenienced if that crossing were closed. If those who are thus affected prevent the closing of the old crossing, then no contribution from the Fund is permitted towards the new crossing facilities. This limitation minimizes the fact that a properly planned highway diversion will channel the majority, if not almost all, of the vehicular traffic to the new crossing and the consequent reduction of highway traffic at the old crossing will appreciably reduce the accident hazard. For this reason, it would appear that if the Board were satisfied that almost all of the highway traffic would be diverted to a new grade separation a grant from the Fund would be justified.

Railway Relocations

The Board received submissions concerning the relocation of railway lines within city limits, involving the cities of Regina, Hamilton, Quebec, Fredericton, Saint John, Summerside and Charlottetown. These were urged for various reasons but in every case the removal of grade crossings that were either dangerous or obstructing the flow of traffic was a principal reason.

The relocation of railway lines is one of those drastic surgical operations that sometimes must be performed on growing urban centres when vehicular traffic reaches an intolerable degree of congestion. While there is an important safety element in such projects, yet if grade crossing problems are one reason for relocation, it is also true that traffic bottlenecks are equally important reasons. Railway lines through the centres of cities tend to give rise to either or both of these problems. In the interests of safety the number of grade crossings are reduced by closing all but the main streets and the danger may be eliminated by building grade separations at these particular streets. While this solution avoids the delays and dangers resulting from trains using or occupying the crossing, it is often at the expense of creating heavy traffic congestion on city streets because the few subways or overpasses act as bottlenecks through which traffic must be funneled.

Another point in connection with railway relocation is that the railway itself may be equally benefited along with the city. Railway lines through built-up areas have generally been located for many years in their present positions. During that time expansion of traffic has generally created the need for more space for railway yards, sidings, team tracks, freight sheds, etc. A removal of railway plant to an area outside the city limits where there is ample space to plan railway facilities in keeping with modern requirements can be of substantial benefit to the railway.

Neither of these reasons, viz: the road traffic bottleneck or congested rail facilities, are directly concerned with the problem of grade crossing protection, and the costs involved may be out of all proportion to those incurred even in large grade separation projects. This being the case, it is our view that railway relocation projects, particularly in urban areas, being undertaken for

many reasons besides that of crossing protection or removal, should properly be excluded from obtaining grants from the Fund. We are not unmindful of the advantages to be gained from such projects by both the railways and the municipalities, but if these were to be included in the obligations of the Fund, it could only mean that a large number of necessary grade crossing projects could not be assisted. We feel that relocations are large-scale capital improvement projects for both the railways and the municipalities.

There are often important economic advantages accruing from such projects which suggests that they are not entirely to be regarded as a necessary burden. There is obviously much that could be done in reorganizing railway and highway layouts in and around urban areas, but we are of the opinion that if public funds are to be contributed toward such projects, they should be contributed on the basis of a study of the merits of specific projects. These projects are of a size and variety that make it inexpedient to class them with ordinary grade crossing projects, and the rules and conditions devised for making grants to the latter type of project are unsuitable for application to relocation projects as a class.

Maintenance Costs

The costs of maintenance (including operation) of crossing protection devices has become a matter of growing concern; this not only because it is a recurring expense, but also because as a recurring expense it may indirectly be the cause of postponement of new installations. Representations have been made to us that the maintenance burden is as difficult for many municipalities to bear as is the capital expenditure, and that therefore the Fund should contribute towards maintenance costs of protective devices at crossings.

Maintenance is admittedly an expensive item. Several years ago, when the automatic bell, the automatic danger sign, or the automatic wigwag were accepted types of automatic signal protection, the average annual maintenance costs approximated two hundred dollars. Today, however, these types are obsolete and the average annual maintenance costs on their replacements, at 1953 cost levels, amount to \$560 for automatic flashing lights and \$865 for automatic short-arm gates. A municipality required to pay one half of such expense for each of several installations soon diverts a substantial amount of funds to this purpose. Even more so the railways, who are involved in every installation, find here a growing burden, and if one contemplates an extensive program of crossing protection, it is obvious that the burden must increase. That even on the present basis the cost of maintenance is increasing is evident from Canadian National expenditures; in 1948 these approximated \$156 000, in 1953 \$246,000. These figures do not include the expense of watchmen at crossings which in 1948 was \$690,000 and 1953 exceeded \$895,000.

Representations made to us on the matter of maintenance varied but the two principal suggestions were that the Fund should assume one-third of the maintenance costs, or that maintenance costs should be divided amongst the parties in the same ratio as would be the capital costs. This latter suggestion would, in the light of our recommendations respecting the sharing of capital costs, mean that the Fund would assume 60 per cent of the maintenance costs.

The question of whether or not the Fund should contribute towards the costs of maintenance, and if so to what amount, is a difficult one. It does seem to us, however, that this is a matter to be determined on the very broadest grounds. We do not think it would be realistic to contemplate the Fund being enlarged to such an extent that it could assume a substantial share of both the capital and maintenance costs and at the same time permit an expanded program. We do think it is necessary to determine what avenues of expenditures

would return to the people of Canada the greatest possible benefits, for the choice is not merely between capital expenditures and maintenance but also involves possible relaxation of the rules of the Fund in other respects.

Because of the fact that the assumption of a share of the annual maintenance costs by the Fund would create a continuing liability, we believe that any steps in this direction should be most carefully considered. Nevertheless we feel that the cost of maintenance has been and will undoubtedly be increasingly a deterrent to grade crossing protection projects, particularly where small or financially weak municipalities are concerned. An expenditure for a capital improvement requires to be voted but once, and can be undertaken when the means are seen to be available. Maintenance expenditure, however, is in the nature of an overhead or fixed cost which may increase as general costs increase and cannot be amortized. For some municipalities it may be entirely out of the question to pledge future tax revenues in this way. The railways' position is similar.

For these reasons, it would seem in order that the Fund assume some share of the maintenance costs, since a good proportion of these will be incurred as a result of the proposed extended aid to new projects in the coming years. We would recommend that a fixed amount of \$200 be the contribution from the Fund toward annual maintenance and operation charges only on automatic signals installed at crossings after the date this provision takes effect. Where maintenance of such installations was less the amount contributed would be only the total amount actually spent on maintenance. The remaining maintenance costs would be apportioned according to principles already laid down or previous practices of the Board.

It has not been possible to recommend a larger contribution toward maintenance from the Fund since we have considered it undesirable that the proportion of maintenance to capital expenditures met from the Fund should be allowed to become unduly large. Even so, with a \$200 contribution to maintenance, it would require only 250 new automatic signal installations to bring the maintenance expenditures from the Fund to \$50,000 per annum, or 1 per cent of the annual grant of \$5,000,000 which we have proposed. This would represent the average Fund contribution to some 10 or 12 automatic signal installations in any one year.

Presumably, however, this amount would continually increase, being offset only by the substitution of grade separations for automatic signal protection or the closing of some crossings. At the present stage of crossing protection it cannot yet be estimated how long this trend would continue, but a point should eventually be reached when automatic signal protection has been pushed to its economic limits.

Projects at Crossings Constructed Subsequent to 1909

Section 263 of the Railway Act provides that if the railway was constructed across the highway subsequent to 1909 the railway shall, in the absence of an agreement with the highway authority to share the expense, pay the entire cost of protection and Section 265 provides that under this condition no grant shall be payable from the Fund. On the other hand we note that no similar provisions apply in the case of a highway constructed across a railway subsequent to 1909; here the Board may, under Section 262 apportion the costs between the parties.

Whatever may have been the justification at one time for treating these undertakings in a different manner, we are unable to conclude that justification exists today. Notwithstanding that the railway may, by first obtaining the required agreement with the highway authority, make this provision of no consequence, we are of the opinion that this restriction should be removed so

that the Board may apportion the costs of projects undertaken irrespective of the date they came into existence or were constructed, or of the party by whom they were established.

A similar recommendation could be made with regard to Section 265 subsection 1 where a distinction is made between crossings in existence on April 1, 1909 and crossings constructed after that date. To the extent that this distinction reflects an aim to restrict the use of the Fund in connection with existing crossings only we are in agreement with it, but this purpose is no longer served by reference to a date 45 years ago. In this connection we recommend that no contribution from the Fund may be made to a crossing until it has been in existence as an authorized public crossing for a period of three years.

Removal of Facilities of Public Utilities

The principle which the Board follows in respect of apportionment of costs incurred by the Bell Telephone Company of Canada and other public utilities in moving their wires and facilities to permit grade separation or other protection at level crossings was stated by Guthrie, Chief Commissioner, in 1937 in the case of Bell Telephone Company v. C.N.R., 46 C.R.C. 329 at 336-40 in the following words:

"The general principle upon which the Board has acted for many years may be briefly stated as follows: When an application is made for grade separation by a railway company, or by a municipality, either for the greater convenience or facility of the applicant in the movement of traffic or for the re-arrangement of streets and which may ultimately result in affording greater protection and safety to the public who use the crossing, the Board deems that the matter of greater convenience or improved facility to the applicant constitutes the main purpose of the application, and that improved crossing protection is merely incidental to the main purpose. In such cases where the removal of the plant and equipment of utility companies is ordered, the cost of such removal is placed upon the applicant. Upon the other hand, where the paramount reason for grade separation appears to be the protection, safety and convenience of the public in the use of the crossing, and where the removal of the plant and equipment of utility companies becomes necessary, the Board has decided in many cases that under such circumstances the cost of removal and erection of equipment should be borne by the utility companies. While it is true that utility companies neither create nor aggravate the danger at grade crossings, nor do they benefit from grade separation, the Board has always considered that where the project is in reality *pro bono publico*, utility companies should bear the expense of moving their plant and equipment for the free use of streets enjoyed by them."

The Bell Telephone Company of Canada has objected in a number of cases to this principle and presented a seventy-eight page brief during the present investigation in which it submitted that the Board should ensure that when private property of utility companies is injuriously affected by an alteration in the grade of the street, even if the alteration is made in the public interest, the utility companies are compensated for this injurious affection by being reimbursed the full amount of their costs in relocating their facilities to accommodate them to the new street condition or grade; furthermore that it is unjust and inequitable to discriminate against such utility companies, which neither cause nor contribute to the danger, by compelling them to bear the whole cost of altering their facilities.

The principle above mentioned was considered by the Supreme Court of Canada in 1939 in C.N.R. v. Bell Telephone Company, 50 C.R.T.C. 10, and Bell Telephone Company v. C.N.R. 50 C.R.T.C. 22. The Supreme Court stated, *inter alia*,

"It has already been observed that, while it is, no doubt, the duty of the Board of Railway Commissioners to act reasonably in discharging the responsibility involved in the exercise of its powers and not arbitrarily and capriciously, the Railway Act does not afford any rule or guide, nor does the law afford any rule or guide, by which the Board is or can be governed in determining what, in the circumstances of any particular case, is the reasonable order to make under ss (2) of s. 39 in respect of the allocation of costs. The Board itself has adopted a principle fully explained in the passages quoted from the judgment of the Chief Commissioner which it has followed in making orders as to costs where works ordered by the Board in connection with highway crossings have involved in their execution the removal of the plants of what are commonly known as public utility companies. It is entirely within the competence of the Board to lay down and follow such a rule of practice which, no doubt, it has found to be a just and reasonable rule."

and the Supreme Court dismissed the appeal by the Bell Telephone Company on certain questions including the following question: "Had the Board jurisdiction to order the utility companies affected to move their facilities at their own expense and without compensation in the circumstances in this case?"

As the objection is not to the legislation under which the Board acts, but to the principle which the Board follows, which it may change if it sees fit, the Board does not recommend any change in the Railway Act in this connection.

XI. Co-operative Committees

Sound public policy respecting a program of grade crossing protection and separation rests largely upon making a proper determination of the order in which the projects should be undertaken. Unless a priority system is established there is no assurance that the first projects to be undertaken would be those where needs are the greatest.

The general basis of priority systems consists of comparing the costs of installing protective devices with the monetary value of the benefits expected to result therefrom, so as to determine the rates of return over cost which would be obtained from each of the various possible undertakings. Then a work program would be drawn up wherein the first projects to be undertaken would be those showing the greatest rate of return over cost.

While we must acknowledge the basic soundness of the priority system approach, it does not appear that the grade crossing problem as we have found it to exist could be brought within manageable limits, by this means, in any reasonable time. Representations made to us stressed the urgency of doing something now. Certainly the Board is not presently equipped with sufficient technical personnel to undertake the nationwide survey which this approach requires. We are of the opinion that the priority system can be most effective when the number of crossings to be dealt with is significantly less than the many hundreds which this Board could, conceivably, be called upon to evaluate. This seems to point to the individual provinces as being the ones best able to determine their own priority ratings. Not only are the provinces most aware of the

particularly hazardous crossings within their boundaries, but they have experienced highway engineering personnel who are constantly dealing with these specialized matters.

A number of suggestions were advanced before us regarding ways and means by which other parties might, on a continuing, co-operative basis, be of aid to the Board in determining an annual program for crossing projects. Generally these were referred to as "advisory committees", "advisory councils", "special committees", or "cooperative committees". The general basis of the proposals was the establishment of a committee consisting of representatives of the provinces, the larger municipalities and the railways which would meet at least once a year with the Board and assist in drawing up the main outlines of the grade crossing program for the ensuing year.

The Canadian National Railways, which suggested the formation of an "Advisory Council" stated:

"The Canadian National's plan is that the Board and its Advisory Council would meet yearly, or more frequently if necessary, to plan the work for the year ahead, within the framework of the National Plan. Each province or railway could present its proposals for the works of protection or elimination it wishes to have undertaken, on a priority basis, and seek allocation of federal and other funds to these works if the Board agrees they are justified. No doubt the provinces and the railways would have opportunities to discuss their proposed projects informally before the annual meetings, and everyone should be prepared at the meeting to finalize the program of works for the ensuing year and the allocation of funds therefor. In cases of disagreement over allocation of costs or other matters, the Board would carry out its normal function and decide the issues with or without a public hearing, as it deemed desirable."

"If the provinces would agree to represent all highway authorities in their province, then they could coordinate their various municipal demands and requirements into the provincial proposals and thus secure allocation of funds on a province-wide basis of priority. Each year the provincial representatives at the Advisory Council meeting would come there, having canvassed the whole provincial scene, and present a clear picture of what the province wants done and is willing to pay for. If practicable the provincial submission would cover the requirements of its municipalities, and the province would settle with them how they are to divide amongst themselves that part of the cost which is to be borne by the highway authority."

With reference to the function of the proposed Advisory Council, the Canadian National suggested that these might include amongst others (1) the formulation of the details of a national grade crossing plan, which plan would be "the joint product of all interested parties and form a basis for yearly work and expenditure by them and the Board", (2) the promotion of uniform provincial legislation respecting traffic regulations at grade crossings, (3) consideration of the possible diversion of highways and railways or the relocation of railway yards and facilities so as to eliminate grade crossings, (4) educational matters, and (5) the uniformity of grade crossing warning signs.

While there is much to be said for the systematic approach to the problem that would result from the establishment of a national committee representative of all interests, in our view, it would be preferable to consider this as a second step in carrying out a national plan rather than as the initial step. A national committee formed at the present time would run the risk of being unwieldy in

size because of the large number of parties who would be ready to participate. As the work to be done must be done on a cooperative basis no strict limitation of representation would be feasible.

Nevertheless the widespread concern with the problem of reducing or preventing grade crossing accidents is ample justification for the establishment of informal advisory committees. For the time being, these should be on a provincial basis. Apart from the difficulties of working through a large national body, provincially-organized committees would permit a great deal of the necessary preliminary work to be done more expeditiously. By this means, municipal and other representatives would become more quickly conversant with the general aspects of the problem and the particular needs within their own province and what actions could be undertaken to meet these needs.

If The Railway Grade Crossing Fund is increased and made available to the extent and in the manner we recommend, a basis for future planning will be provided. To a marked degree, the success of such planning will depend upon the co-operation given in the matter by all parties. In order that the various interests might be enabled to coordinate their respective proposals, the individual provinces might wish to give consideration to the establishment of such provincial committees including thereon representatives of the appropriate provincial departments, the larger municipalities, one or more persons to represent rural municipalities, the railways and interested bodies. Each provincial committee could receive proposals, make a preliminary general assessment of their need and fit them into a program which, province-wide, would tentatively represent a priority listing of undertakings which the committee considered would be feasible and practicable to undertake during the subsequent year.

This would provide the Board with a general outline of crossing projects, province by province, which the various committees, having regard to the seriousness and magnitude of individual undertakings and the availability of funds, deemed of sufficient importance as to warrant inclusion in the program for that particular year. The Board would then be in a position to assess the relative merits of the proposed undertakings, hold such hearings and make such investigations as might be required, and then in conjunction with the highway authorities concerned establish the priority of each project so as to authorize first the work where the need appeared to be the greatest.

We do not consider that the committee's proposals would in any degree be final; rather that they would constitute the basis from which the Board could formulate a comprehensive, well-balanced national plan for the use of the Fund. It need not be that a project not included in the committee's proposals would thereby be ineligible for such assistance as the Fund might provide; the Board would still be open to receive applications under the procedure now provided for. In cases of disagreement over the allocation of costs or other matters, the Board would carry out its normal function and decide the issues with or without a public hearing as it deemed desirable.

In addition to the very helpful assistance such voluntary committees could render the Board in program planning, there are other aspects of the grade crossing problem on which the provincial committees could make a very worthwhile contribution.

As stated elsewhere, very serious representations were made to us respecting the warning signs which are placed on the side of the highways in advance of grade crossings. The evidence would indicate that uniformity of signs, and their placement, together with improved marking, are thought by many people to be relatively inexpensive means of obtaining a significant reduction in rail-highway crossing hazards. Allied to these suggestions were those having to do

with matters of highway construction, including gradients and angles of approach, and pavement markings. Other suggestions, more closely allied to motor vehicle operation, including those of an educational nature respecting public observance of grade crossing signs and protective devices, compulsory speed reduction and compulsory stopping of vehicles under certain conditions, and the strict enforcement of prescribed highway safety regulations were placed before us.

These are matters not within the jurisdiction of the Board but, nevertheless, they are of interest to the Board and might usefully meet with the attention of the provincial committees herein elsewhere suggested, as they constitute a part of the overall problem of highway accidents concerning which there is a rapidly mounting national awareness.

XII. Considerations Leading up to Recommendations

The number of accidents occurring at grade crossings in recent years has been increasing instead of diminishing, notwithstanding federal assistance, as provided by the Fund.

To the extent that such accidents are attributable to careless driving, which all too frequently occurs at well protected crossings, the remedy probably lies in expanded safety educational programs and more stringent highway laws and more rigid enforcement thereof but these aspects of the matter lie outside the scope of the Fund.

In respect of accidents which better or more protection might serve to prevent, it is considered that the time has arrived when the federal authority could appropriately give a more emphatic lead in assisting to provide needed remedies. Such a lead, however, we believe, will prove ineffectual unless it is closely followed by the other contributing bodies, particularly the provincial authorities which have relatively wide powers of taxation and likewise by municipalities and the railways.

As a partial remedy it is thought that the present limit of The Railway Grade Crossing Fund, amounting to \$1,000,000 per annum, should be immediately and markedly increased and that, in terms of a percentage contribution, the present limit of 40 per cent should be appreciably augmented. At the same time, for the present rigid provisions of the Fund which provide for an annual contribution of \$1,000,000 expiring in the fiscal year 1956-57, there should be an increased amount on an annual basis which might be augmented or decreased in the light of experience.

A new approach, administratively speaking, insofar as the application of the Fund is concerned, is believed to be necessary in order to effectively diminish existing dangers to public safety and to better public convenience.

In furtherance of the aforementioned belief, the Board is convinced that the present piecemeal unco-ordinated method of attacking the grade crossing problem should give way to a closer knit and broader arrangement of presenting and assessing applications, and means should be devised whereby applications could be considered in bulk rather than individually and that the disposition of such applications should be accelerated. It is believed that the possible success, in the foreseeable future, of such modifications will principally depend upon the degree of co-operation and enthusiasm put forth by the provincial and municipal authorities and the railways, and the extent to which the Board, as administrators of The Railway Grade Crossing Fund can provide expeditious and intelligent direction.

In order that applications may be dealt with en bloc and on a yearly basis, it is suggested that, if provincial authorities are agreeable to do so, the Board invite them to set up a representative advisory committee in each province which would each year assemble all applications, whether provincial or municipal, which it would be feasible to proceed with during the course of the next calendar year, and submit the same to the Board before the end of each calendar year with suggestions as to their order of priority. Thus it would be possible for the Board to prepare an overall yearly program for the whole of Canada, keeping in mind the amount which would be available in the Fund and the amount involved in carrying out the various programs by provinces, with a view to proceeding with selected projects as rapidly as finances would permit. This would likewise place the Board in a position to reconcile where necessary, the desire of the more wealthy provinces to proceed with extensive, cost-consuming programs and the reasonable concern of the less wealthy provinces, lest the Fund should be thus depleted to their detriment.

It is also desirable that the present uncertainty as to the distribution of costs of grade separations or grade crossing protection should be removed as far as possible.

It is considered, in this connection, that because of the variety of circumstances and the larger sums involved in the elimination of grade crossings by the construction of overpasses and underpasses, it is not possible to lay down in advance any division of costs which would approach a rule of thumb and that each grade separation, insofar as the apportionment of costs is concerned, would have to be dealt with on its own merits.

With respect to grade crossing protection, however, it is thought that the Board might advantageously make known from time to time a set of general rules which it would follow in apportioning the cost thereof, subject to modification in special cases, so that parties would know before making applications what proportion of the cost each party would be normally expected to assume.

Although it is the case that the most ideal manner of protecting and convenience the public at grade crossings is to eliminate such crossings by the installation of grade separations, nevertheless, for the immediate future, it is thought that protection at grade crossings should be emphasized. Although both are required, it is the view of the Board that increased safety is more urgent than greater convenience and that the accident rate is more likely to diminish if more attention is given to added protection and that this is possible on a more extended scale with expenditure of less money than if the accent were placed on grade separations. It is not meant that this suggestion should be interpreted as meaning that grade separations are to be neglected.

It would be a welcome development if less costly but at least equally effective warning signals and protective devices at crossings were devised and since it seems evident that proportionately more railway crossing accidents happen at night than by day, it is important to make more effective, particularly by night, the approach and crossing signals and devices.

The greater the augmentation in newly installed warning signals and devices, the more will be felt the burden of maintenance thereof by the railways, the provincial authorities and municipalities, and some of the smaller municipalities lack the means to support such burdens.

In keeping with the desirability of having the federal authority give a further lead, in the Board's opinion, the Fund might be called upon to alleviate the burden of maintenance to some extent.

The present provisions of the Railway Act leave it open to the provinces to contribute to the Fund but, heretofore, the provinces have not done so and have preferred to deal with each case as it arises.

Since, under the present Railway Act, the Board, while having jurisdiction over the railways and municipalities in grade crossing matters, has no jurisdiction to compel the provinces to bear the cost of protection or grade separations, the Canadian Pacific Railway offered the suggestion that the Railway Act should be amended so that the Board's jurisdiction would be extended over the provinces to the same extent as over the railways and municipalities. The Board at present is not inclined to recommend the suggested extension of its authority. Throughout the hearings, there was abundant evidence to show that the provinces on the whole—while varying in degree—are ready and anxious to co-operate with the Board and, where practicable, to aid financially deficient municipalities; accordingly, the Board considers that more can be accomplished through provincial co-operation than by extension of the Board's jurisdiction.

At present, where as a result of highway diversion, a grade separation is created, no contribution from the Fund may be made to the initial cost thereof unless an existing crossing is completely closed and it is thought that this provision is unnecessarily restrictive and could be relaxed to some degree.

Six or more cities suggested that many dangerous and traffic congested crossings might, with great benefit to the public, be eliminated if the railways removed their stations and freight yards outside the city limits. It is true that there was a time when cities were anxious to induce railways to run through the centre of the city or town and were prepared to make, and did make, tax and other concessions in order to bring this about. It is also a fact that, with the increased volume of motor traffic and the ensuing congestion, these same cities or towns now would be disposed to do almost anything in their power to have the railways remove themselves to the outskirts, or reduce the number of tracks entering the city or town. While the Board realizes that such a remedy has real possibilities and is deserving of serious consideration, the magnitude of the financial considerations entailed is so great that these undertakings do not lend themselves to remedial action being taken through the medium of the Fund but might be fostered by means of special federal grants as and when circumstances might so warrant.

Similar large scale projects involving the relocation of highways may also result in a substantial reduction of the number of grade crossings and although there are notable differences between the relocation of railways and that of highways, the above observations regarding railways, at least in part might be applicable in the case of highways.

Throughout the hearing multiple and unanimous recommendations were made regarding the desirability of deleting the present restriction in the Railway Act which makes it impossible for the Board to make contributions from the Fund to highway crossings of railways at rail level constructed after the 1st of April 1909, unless there is an agreement approved by the Board between the railway and highway authorities whereby the latter agree to bear a portion of the cost.

There were also unanimous recommendations for an extension of the Fund to provide for contributions towards the cost of improvement or reconstruction of existing inadequate grade separations.

In both cases the Board considers that modification of the Railway Act is called for.

XIII. Recommendations with Regard to the Railway Grade Crossing Fund Entailing Changes in the Railway Act.

Our recommendations regarding The Railway Grade Crossing Fund which entail changes in the Railway Act may now be summarised as follows:

1. Until Parliament enacts otherwise there should be an appropriation of \$5,000,000, instead of the present \$1,000,000, to the Fund each year from April 1, 1954, with a proviso that where on April 1st in any such year there is an uncommitted balance of more than \$2,000,000 in the Fund the appropriation for that year should be such sum as with the uncommitted balance will amount to \$7,000,000.
2. The contribution presently provided for, of 40 per cent of the cost of the actual construction work for the protection, safety and convenience of the public, with a maximum of \$150,000, in respect of any one crossing at rail level, should be increased to 60 per cent and \$300,000 respectively.
3. The Fund should be made available to aid reconstruction and improvement of grade separations in existence at crossings when the amendment comes into force and which because of their location, design or size are inadequate for the highway traffic using them, the contribution in any one case not to exceed 30 per cent of the cost of reconstruction and improvement nor exceed \$150,000.
4. Contributions should be permitted towards the annual cost of maintenance and operation of automatic signals installed at crossings after the amendment comes into force, the contribution in respect of any one crossing not to exceed for any year the actual cost for that year nor exceed \$200.
5. The provision in subsection (1) of section 265, which prevents a contribution from the Fund in respect of crossings at rail level constructed after April 1, 1909, unless there is the agreement referred to in the subsection between the railway company and a municipal or other corporation or person, should be eliminated, but there should be a provision that the Board shall not apply any money out of the Fund towards the cost of work in respect of a crossing unless the crossing has been in existence for at least three years prior to the making of the Board's order to apply the money.
6. The Board should be expressly empowered to make contributions where it sees fit towards the cost of highway projects which involve the construction of a grade separation and the closing of an existing crossing or the diversion from the existing crossing of nearly all the highway traffic using it.
7. Section 263 of the Railway Act, which places on the railway company, unless and except as otherwise provided by an agreement approved by the Board, all cost of protection, safety and convenience of the public in respect of any crossing of the highway where the railway is constructed after May 1909, should be repealed.
8. That the Railway Act be amended to give effect to the foregoing recommendations.

Acknowledgements

The work of the Board in conducting the survey and making a report on the methods best calculated to eliminate the hazards and improve the convenience and the safety of the public at grade crossings has been greatly facilitated by the helpful suggestions given and the co-operation shown by the Ministers and Deputy Ministers of the Provinces; the Mayors and City Officials of various municipalities, and their counsel. The same is true of representatives

and counsel of the Boards of Trade, Motor Transportation Associations, Safety Leagues, Good Roads Associations, Transportation Brotherhoods, the Railways and all others who took part in the inquiry.

The whole of the foregoing is respectfully submitted.

JOHN D. KEARNEY,
Chief Commissioner.

ARMAND SYLVESTRE,
Deputy Chief Commissioner.

FRANK M. MacPHERSON,
Commissioner.

H. B. CHASE,
Commissioner.

OVERTON A. MATTHEWS,
Commissioner.

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